

AIDS TO SURGERY

BY

CECIL A. JOLL

M.S.(LOND.), M.D.(BRIS.), B.Sc.(LOND.), F.R.C.S.(ENG.)
SENIOR SURGEON AND LECTURER ON SURGERY TO THE ROYAL FREE
HOSPITAL; SENIOR SURGEON TO THE ROYAL CANCER HOSPITAL;
SENIOR SURGEON TO THE MILLER GENERAL HOSPITAL; CONSULTING
SURGEON TO THE ROYAL BUCKS HOSPITAL; ETC., ETC.

AND

REGINALD C. B. LEDLIE

M.B., B.S.(LOND.), F.R.C.S.(ENG.)
SURGEON TO THE ROYAL CANCER HOSPITAL; SURGEON TO THE
MILLER GENERAL HOSPITAL; SURGEON TO THE EAST HAM
MEMORIAL HOSPITAL; ETC.

ILLUSTRATED BY

H. H. GREENWOOD

M.B., B.S.(LOND.), F.R.C.S.(ENG.)
LATE CONSULTING SURGEON, G.W.R. HOSPITAL, SWINDON

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PREFACE TO THE SEVENTH EDITION

THE call for a new edition has provided an opportunity for a thorough revision of those sections in which important advances have been made during the past five years. It has been found necessary to add a considerable amount of new matter, but we have to some extent compensated for this by eliminating what appeared to be out of date—or out of place in a small book of this kind.

Special attention has been devoted to the surgery of injuries, not only because of the war, but also owing to the increasing importance of industrial and road accidents in the life of the community. This section, therefore, has been completely rewritten, and is based on the admirable monograph, "Fractures and Other Bone and Joint Injuries," by Mr. R. Watson-Jones (*E. and S. Livingstone*).

We have been fortunate in securing the valued services of Mr. H. H. Greenwood for all the new illustrations, which it is hoped will enhance the utility of the book.

We take the opportunity to thank our colleagues and correspondents for valuable suggestions and criticisms, most of which we have tried to make use of in this revision.

C. A. J.
R. C. B. L.

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CONTENTS

CHAPTER	PAGE
I. INTRODUCTION AND GENERAL PRINCIPLES - - - -	I
II. INFLAMMATION - - - -	5
III. NON-SPECIFIC INFECTIONS - - - -	12
IV. SURGICAL INFECTIVE DISEASES - - - -	22
V. WOUNDS AND SHOCK - - - -	43
VI. HÆMORRHAGE - - - -	55
VII. TUMOURS—RADIO THERAPY—CYSTS - - - -	61
VIII. INJURIES AND DISEASES OF BLOOD-VESSELS - - - -	81
IX. INJURIES AND DISEASES OF THE LYMPHATIC SYSTEM - - - -	96
X. INJURIES AND DISEASES OF NERVES - - - -	101
XI. AFFECTIONS OF MUSCLES, TENDONS AND BURSÆ - - - -	115
XII. SURGICAL DISEASES OF THE SKIN - - - -	121
XIII. DISEASES OF BONE - - - -	126
XIV. DISEASES OF JOINTS - - - -	144
XV. DEFORMITIES - - - -	160
XVI. ULCERATION AND GANGRENE - - - -	184
XVII. FRACTURES AND DISLOCATIONS - - - -	194
XVIII. INJURIES OF THE UPPER LIMB - - - -	205
XIX. INJURIES OF THE LOWER LIMB - - - -	227
XX. INJURIES OF THE SPINE AND PELVIS - - - -	248
XXI. DISEASES OF THE SPINE - - - -	258
XXII. AFFECTIONS OF THE SCALP AND CRANIUM - - - -	269
XXIII. DISEASES OF THE BRAIN AND MEMBRANES - - - -	282
XXIV. AFFECTIONS OF THE LIPS AND JAWS - - - -	292

CHAPTER	PAGE
XXV. AFFECTIONS OF THE MOUTH, SALIVARY GLANDS AND PALATE - -	305
XXVI. AFFECTIONS OF THE NOSE AND NASOPHARYNX - - -	322
XXVII. AFFECTIONS OF THE TONSIL AND PHARYNX - - -	329
XXVIII. AFFECTIONS OF THE OESOPHAGUS -	334
XXIX. AFFECTIONS OF THE EAR - -	341
XXX. AFFECTIONS OF THE NECK - -	348
XXXI. AFFECTIONS OF THE AIR PASSAGES AND CHEST - - -	367
XXXII. INFECTIONS OF THE HAND - -	386
XXXIII. AFFECTIONS OF THE BREAST - -	392
XXXIV. AFFECTIONS OF THE ABDOMEN AND PERITONEUM - - -	406
XXXV. HERNIA - - -	419
XXXVI. AFFECTIONS OF THE STOMACH AND DUODENUM - - -	440
XXXVII. AFFECTIONS OF THE INTESTINES—INTESTINAL OBSTRUCTION -	459
XXXVIII. AFFECTIONS OF THE APPENDIX -	485
XXXIX. AFFECTIONS OF THE LIVER, BILIARY PASSAGES, PANCREAS AND SPLEEN -	492
XL. AFFECTIONS OF THE RECTUM AND ANAL CANAL - - -	515
XLI. AFFECTIONS OF THE KIDNEYS, URETERS AND SUPRARENALS - -	540
XLII. AFFECTIONS OF THE BLADDER, PROSTATE AND VESICULÆ SEMINALES -	564
XLIII. AFFECTIONS OF THE URETHRA AND PENIS - - -	593
XLIV. AFFECTIONS OF THE SCROTUM, TESTIS AND SPERMATIC CORD - -	606
INDEX - - -	621

LIST OF ILLUSTRATIONS

FIG.	PAGE
1. Sensory Changes following Division of Median Nerve in Forearm - -	110
2. Sensory Changes following Division of Ulnar Nerve in Forearm - -	111
3. Effects of Complete Division of Great Sciatic Nerve and Effects of Complete Division of External Popliteal Nerve -	113
4. Sympathetic Nerves of Abdomen and Pelvis	114
5. The Spread of Osteomyelitis - -	129
6. Schema of Generalized Osteitis Fibrosa due to Parathyroid Tumour - -	139
7. Tumours of Bone - - -	142
8. Illustrating Various Conditions of the Hip	171
9. Fixed and Balanced Traction - -	199
10. Methods of Bone Grafting - -	201
11. Fractured Neck of Humerus - -	209
12. Fractured Shaft of Humerus - -	213
13. Supracondylar Fracture of Humerus -	216
14. Colles' Fracture - - -	221
15. Fractures of the Carpal Scaphoid - -	223
16. Bennett's Fracture-Dislocation - -	225
17. Fractured Neck of Metacarpal - -	225
18. Fractured Phalanx - - -	226
19. Fractures of Lower End of Femur - -	233
20. Fractures of Tibial Tuberosity - -	239
21. Watson-Jones's Tibia Traction Apparatus -	240
22. Fracture-Dislocations of the Ankle - -	242
23. Fractures of Os Calcis - - -	246

FIG.	PAGE
24. Subastragaloid Fracture-Dislocation -	241
25. Method of obtaining Hyperextension in Fractured Spine - - -	241
26. Tender Points in Low Back Strain - - -	254
27. Fracture-Dislocation of the Pelvis - - -	257
28. Varieties of Spina Bifida - - -	259
29. Pathology of Pott's Disease of Dorsal-Lumbar Region - - -	262
30. Transverse Section of Neck illustrating Mode of Spread of Retropharyngeal Abscess - - -	263
31. Cerebral Localization - - -	290
32. Varieties of Cleft Palate - - -	320
33. Illustrating Complications of Middle-Ear Disease - - -	341
34. Cysts in Connexion with the Thyro-Glossal Tract - - -	353
35. Illustrating Surgical Anatomy of Simple Goitre - - -	356
36. Operations for Goitre, illustrating Amount of Gland removed as seen in Transverse Section - - -	364
37. Flexor Tendon Sheaths of the Hand and Incisions for Drainage - - -	387
38. Fascial Spaces of the Hand and Incisions for Drainage - - -	387
39. The Spread of Carcinoma of the Breast -	401
40. Surgical Anatomy of Subphrenic Abscess -	414
41. Sliding Hernia - - -	421
42. Illustrating Types of Inguinal Hernia -	429
43. Surgical Anatomy of Inguinal and Femoral Hernia - - -	430
44. Ectopic Testis in Interstitial Hernial Sac -	431
45. Illustrating Important Gastric Operations -	441
46. Lymphatic Spread in Carcinoma of the Stomach - - -	454

LIST OF ILLUSTRATIONS

xi

IG.		PAGE
7.	Illustrating Mode of Production of Diverticulosis - - - - -	464
8.	Diagram of Skiagraphic Appearances in Diverticulosis and Diverticulitis - -	465
49.	Illustrating Varieties of Intussusception -	479
50.	The Surgical Anatomy of the Biliary Passages - - - - -	499
51.	Illustrating Ano-Rectal Fistulæ - -	522
52.	To illustrate Lymphatic Drainage of Rectum and Sigmoid Colon - - -	537
53.	Scope of Operation in Abdomino-Perineal and Perineal Excision of Rectum -	540
54.	Illustrating Pyelographic Appearances -	542
55.	Illustrating Simple Enlargement of Prostate and its Consequences - -	582
56.	Illustrating Simple Enlargement of Prostate and its Consequences - -	583
57.	Diseases of the Testis - - -	610
58.	Illustrating Varieties of Hydrocœle - -	617

AIDS TO SURGERY

CHAPTER I

INTRODUCTION AND GENERAL PRINCIPLES

THE conditions confronting the surgeon in his daily practice, and for which his art is invoked, may usefully be classified under four main headings:

1. Congenital abnormalities.
2. Injuries.
3. Infections.
4. Neoplasms and cysts.

It is therefore essential that the student of surgery should master first the basic principles of pathology. The reaction of the tissues to injury and infection must be clearly understood in order to ensure that the surgeon will employ his skill to the advantage of the patient, avoiding the fruitless effort to defeat essential pathological principles by mere mechanical ingenuity or the finesse of surgical technique. Many elaborate and heroic operations have been devised and practised by famous surgeons, only to be discarded by posterity as useless and even harmful because the laws of physiology and pathology have been disregarded. After an era in which perfection of technique enabled major procedures to be undertaken almost with impunity, the trend of modern surgery is towards reasoned conservatism. Accessory methods such as chemotherapy, radiotherapy and other forms of physiotherapy are now, therefore, more and more widely employed.

Surgical Diagnosis.—In many instances this can be arrived at by careful study of the history combined

with accurate assessment of the physical signs. Radiology has proved of increasing importance, particularly in the deep-seated lesions. By the injection of substances opaque to X-rays many of the hollow viscera can be outlined and abnormalities both of shape and function detected before physical signs are apparent. Bacteriology, biochemistry and hæmatology have all contributed to earlier diagnosis.

Preoperative Treatment.—Excluding surgical emergencies, in which appropriate treatment for shock and hæmorrhage is essential before operation, there is still much to be accomplished in order that the risks associated with operation and the attendant discomforts may be diminished.

1. If the patient be of a nervous disposition, sedatives should be ordered for at least one night before operation. Barbiturates such as dial or medinal, alone or in combination with bromides and chloral, are very effective in procuring sound sleep.

2. As the patient will frequently be confined to bed for some time after operation, measures should be taken beforehand to ensure easy and regular bowel action. Liquid paraffin, though effective, interferes with absorption of vitamins, and therefore vegetable laxatives such as cascara sagrada or senna are preferable if there is habitual constipation. Drastic purgation by castor oil or the stronger irritants is to be deplored.

3. Excess of food, alcohol or smoking should be avoided, particularly in operations affecting the alimentary or respiratory tracts.

4. Liberal quantities of bland fluids containing glucose should be taken. In diabetics extra glucose should be given, controlled by the appropriate dose of insulin.

5. Special precautions are needed to safeguard patients who are prone to respiratory complications. Expectorants should be combined with inhalations of CO_2 (5 to 10 per cent.) and vaccine therapy may prove of value.

6. Debilitated patients are frequently benefited by a course of ultra-violet light.

7. Focal sepsis should be reduced to a minimum by dental extractions and by attention to oral, nasal, and pharyngeal hygiene, etc.

Anæsthesia.—Great strides have been made since chloroform, ether and ethyl chloride were first employed as inhalation anæsthetics, and to-day advantage is obtained by a combination of local, rectal, intravenous and inhalation methods, together with careful premedication.

1. *Premedication.*—Paraldehyde, omnopon and scopolamine, morphine or heroin, with or without atropine, are employed to reduce sensibility and produce drowsiness.

2. *Local.*—Injection of a solution of 0.5 to 2 per cent. novocain around the operation area often suffices for minor operations. Combined with adrenalin it reduces oozing and minimizes shock in major procedures. In *regional* anæsthesia the main nerves are blocked by infiltration of and around their trunks. In *spinal* anæsthesia a solution of percaine, spinocaine or stovaine is injected into the sub-arachnoid space.

3. *Rectal.*—Anæsthesia can be produced by avertin, but great care is necessary to estimate the exact quantity required by calculation from the patient's body weight.

4. *Intravenous.*—This route has become increasingly popular with both patients and anæsthetists. It has the virtue of simplicity and is relatively pleasant. 'Pentothal' or 'evipan' is the barbiturate usually employed, and the solution must be freshly prepared.

5. *Inhalation.*—Nitrous oxide and oxygen are frequently employed in association with one or more of the above methods. Cyclopropane is valuable when a high degree of muscular relaxation is desired in cases unsuitable for spinal anæsthesia.

Surgical Technique.—Modern surgical technique aims at the exclusion of bacteria from operation wounds, and to this end the following methods are employed:

1. *Operating Theatre.*—Roof, walls and floor should be impermeable and washable, corners rounded and

projections or recesses avoided. Air should be filtered.

2. *Surgeons and Assistants* should be covered by sterilized caps and gowns; masks should be worn which are made impermeable to organisms by a layer of cellophane. Hands and forearms are prepared by scrubbing for three to five minutes with soap and water, then soaked in spirit, or 1 in 500 biniodide of mercury in spirit, and covered with rubber gloves sterilized by dry heat or boiling.

3. *Operation Area*.—This is shaved, cleaned with soap and water, followed by ether to dissolve grease in the skin, painted with spirit, iodine (2 per cent.) in spirit, or picric acid (3 per cent.) in spirit, and covered with a sterile dressing. This preparation should, when possible, be carried out on the day prior to the operation. Omit picric acid or iodine with sensitive skins and use plain surgical spirit.

Before the incision is made, spirit, with or without iodine (2 per cent.) or picric acid (3 per cent.), is painted on the skin and the area surrounded by sterile towels. After the skin incision, sterile towels are also clipped to the skin edges.

4. *Instruments* are sterilized by boiling in 1 per cent. sodium bicarbonate solution for ten to fifteen minutes and laid on a dry sterilized towel. To avoid blunting sharp instruments, they are sterilized by immersion in pure 'lysol' for five minutes.

5. *Ligatures and Sutures*.—Silk, linen thread, silkworm gut and horsehair must be boiled for half an hour. Catgut is prepared by prolonged immersion in various chemicals, such as iodine or chromic acid, and stored in alcohol or xylol.

Silkworm or *salmon gut* is the substance used by anglers for attaching the hook to the line, and is made by dropping the silkworm at the appropriate stage into acetic acid to fix it, and then drawing the body through a drawplate to the required calibre. *Catgut* is made from part of the wall of the sheep's intestine. Careful sterilization is needed to eliminate danger from tetanus spores.

6. *Solutions*.—If irrigation is necessary, sterilized

saline solution (1 drachm to the pint) is suitable for most purposes, but Ringer's solution is desirable in operations on the central nervous system.

7. *Swabs, towels, dressings, gowns, caps, masks and rubber gloves* are usually sterilized by exposure to steam under high pressure and stored in metal drums.

Finally, wounds should be left as dry as possible, and if there is much oozing, as after radical mastectomy, drainage tubes should be inserted. Fresh sterilized dressings must be applied if any discharge soaks through the original one.

N.B.—In the chapters which follow it has been found more convenient to consider inflammations and infections before injuries, as many of the latter are complicated by the former. Congenital abnormalities are dealt with under the regions concerned or in the chapter on deformities, while neoplasms and cysts are considered both in a special section and under the various organs in which they occur.

CHAPTER II

INFLAMMATION

Definition.—The succession of changes occurring in a living tissue as the result of injury, provided that the injury is not of such a degree as to destroy at once its structure and vitality.

Causes.—(1) *Bacteria*. By far the most common and important. (2) *Trauma*. (3) *Heat or cold*. (4) *Chemical agents* (e.g., acids and alkalies). (5) *Electricity*. (6) *X-rays, radium emanations and ultra-violet rays*.

Pathological Changes.—1. *Dilatation* of arterioles, capillaries and veins.

2. *Acceleration* of blood stream followed by retardation, which may progress to stasis and thrombosis.

3. *Exudation* of blood serum (or lymph), leucocytes and red blood corpuscles into tissue spaces.

4. *Proliferation* of connective tissue cells (large hyaline or endothelial cells), and appearance of small round cells which are probably lymphocytes.

Results.—1. *Resolution* with absorption of inflammatory products.

2. *Organization*.—Fibroblasts are formed (possibly from small round cells and hyaline cells) and give rise to new connective tissue (cicatrical tissue).

3. *Suppuration*. Liquefaction of tissues occurs and a collection of fluid containing bacteria, leucocytes and tissue cells is formed (pus).

4. *Ulceration*.—Follows inflammation on or near the surface with destruction of the superficial tissues, including skin or mucous membrane, the resulting raw area being termed an ulcer.

5. *Gangrene*.—Destruction of macroscopical portions of tissue which separate, forming sloughs.

Clinical Signs.—(1) *Heat*; (2) *redness*; (3) *pain*; (4) *swelling*; (5) *loss of function*.

Heat is due to the increased blood flow through the part.

Redness results from dilatation of the vessels and in the early stages disappears on pressure.

Pain is due largely to tension and most marked when inflammation occurs beneath dense fascia (e.g., in the hand).

Swelling is due to the exudation.

Symptoms.—*Fever or pyrexia*.—Associated with this are: (a) Elevation of temperature; (b) acceleration of pulse and respiration; (c) dryness of skin and mouth and furred tongue; (d) loss of appetite, impaired digestion and constipation; (e) scanty, highly coloured urine; (f) delirium, either noisy or muttering; (g) collapse; (h) emaciation if the condition is prolonged.

Treatment.—*Local*: (1) Remove the cause. (2) Rest the affected part. (3) Relieve congestion and stagnation of exudate by (a) free incisions; (b) elevation of dependent parts; (c) leeches; wet or dry cupping; (d) scarification; (e) cold packs. (4) Assist the circulation by (a) continuous hot water baths, hot fomentations or radiant heat; (b) Bier's artificial hyperæmia

induced by a rubber bandage which obstructs the venous return, or by special appliances designed to produce a partial vacuum around the affected area.

General: Aims at increasing the resistance and promoting the excretion of toxins through the skin, bowel and kidneys.

(1) Abundant fluids, especially diluted fruit juices and barley water containing glucose or cane sugar. (2) Light nourishing diet while there is pyrexia. Increase to solid food as soon as the patient regains the inclination. (3) Transfusion of whole blood from a healthy individual or of defibrinated blood from a donor who has received a large dose of vaccine a few hours previously (immuno-transfusion). (4) Serum therapy—antitoxic or antibacterial sera injected subcutaneously, intramuscularly or intravenously in appropriate cases. (5) Chemotherapy (see p. 15).

Chronic Inflammation.

The result of a long-continued and milder injury than in acute inflammation.

Causes.—(1) *The granulomatous diseases*—viz., tuberculosis, syphilis, actinomycosis, leprosy and glanders. (2) *Toxic absorption* from a distant focus of infection (focal sepsis). (3) *Gout*. (4) *Foreign bodies*. (5) *Long-continued pressure*—e.g., bedsores.

Pathological Changes.—(1) *Vascular changes* are less marked than in acute inflammation, and in some cases there is diminution in blood supply due to thickening of the vessel walls (endarteritis). (2) *Connective tissue proliferation* is a pronounced feature. Certain types of cell are found: (a) Small round cells; (b) endothelial cells; (c) plasma cells; (d) giant cells (multinuclear). From some of these new connective tissue is formed.

Results.—1. *Organization* is the rule. Replacement of the normal tissue by white fibrous connective tissue occurs.

2. *Suppuration.*—A localized collection of pus may form a cold abscess (no redness, heat or pain), which

often tracks along fascial planes for a considerable distance.

Treatment.—*Local:* (1) Remove the cause. (2) Rest the affected part. (3) Measures to increase the circulation: counter-irritation, pressure, bandages or elastic supports, massage, radiant heat, ultra-violet light, Bier's hyperæmia.

General: Increase the general resisting powers of the patient. (1) Good hygiene and nourishing diet. (2) Removal of other foci of infection, such as infected teeth or tonsils, diseased appendix or gall-bladder. (3) Vaccines. (4) Specific drugs.

Suppuration.

Suppuration is such a common sequel to the inflammatory process in surgical diseases that a more detailed study of the condition is indicated.

Causes.—In the vast majority of cases bacterial infection, the organisms responsible being termed pyogenic (pus forming); occasionally foreign bodies such as surgical ligatures chemically prepared may be the cause.

Pathology.—The liquefied material is termed pus, and consists of a solution of peptones, suspended in which are bacteria and phagocytes, both dead and living, and tissue cells. Pus may be mixed with blood (sanious), serum (sero-pus), mucus (muco-pus) and in some cases gas which is formed by the causative organism and may give rise to a characteristic odour (*Bact. coli*). In infections with *Ps. pyocyanea* the pus is bluish-green in colour.

When suppuration results from acute inflammation the pus may be localized, forming an acute abscess, or it may spread freely along fascial and muscular planes as in diffuse cellulitis (see p. 18). Chronic inflammation may give rise to a chronic or cold abscess.

Acute Abscess.—A circumscribed collection of pus surrounded by a zone in which acute inflammatory changes are evident. In the early stages hyperæmia and exudation occur, followed later by the develop-

ment of new bloodvessels and young connective tissue (granulation tissue), which in turn becomes white fibrous tissue during the healing process. Thus there is formed the abscess wall, containing in its cavity a liquefied portion—the purulent content.

As an abscess increases in size, spread occurs along the lines of least resistance, some structures being more resistant to liquefaction than others, with the result that abscesses frequently become loculated, or as it is sometimes put, the pus tends to pocket. If left untreated pus may burrow for long distances before the abscess points—*i.e.*, finds its way to the surface and bursts.

One of the most important functions of the surgeon is to diagnose acute suppuration early and anticipate this dangerous process by providing free drainage of all such purulent collections.

Healing of an abscess occurs by the collapse of its walls after the pus has been evacuated, the contraction of the fibrous tissue aiding in the process. Delayed healing is due either to (1) inability of the walls to contract owing to their rigid structure—*e.g.*, abscesses in bone or in the thoracic cavity; or (2) persistent irritation due to such causes as foreign bodies or too vigorous use of chemicals employed in washing out the cavity, prolonged use of drainage tubes and (3) secondary infection.

Signs and Symptoms.—*Local* (in the order of their appearance): (1) Throbbing pain. (2) Brawny swelling which pits on pressure. (3) Fluctuation: the most characteristic sign, but may be simulated by soft tumours such as lipomata and sarcomata, and may be absent when pus is deep-seated or under great tension. (Fluctuation is the transmission by digital pressure of a fluid impulse from one part to another.)

General: (1) Raised temperature. (2) Rigor (intense shivering followed by free perspiration). (3) Leucocytosis—*i.e.*, an increase in the number of leucocytes in the blood stream from the normal 6,000-8,000 to 15,000-40,000 to the cubic millimetre. In acute abscess formation this increase is mainly in the

polymorphonuclear cells, and, provided other causes of such increase, such as diseases of the blood and bone marrow (*e.g.*, leukæmia), can be excluded, a count of 20,000 may be taken as almost certain proof of suppuration. In cases of doubt, successive counts at intervals of twelve to twenty-four hours may reveal a rise in the number of circulating leucocytes and clinch the diagnosis.

Treatment.—(1) Free incision with rigid aseptic precautions. The main incision should, if possible, be at the most dependent part and counter-incisions may be necessary. (2) Opening of the loculated portions into the main cavity. (3) Drainage by rubber tubing or corrugated rubber strips. (4) Aseptic or antiseptic dressings to avoid secondary infection. (5) Avoid damage to the abscess wall at the time of operation, and later eschew strong chemicals.

If the incisions are sufficient and in the correct situation, drainage by tubing can and should be dispensed with within a day or two. Prolonged use of drainage tubes increases the risk of secondary infection, prevents healing, and may cause erosion of bloodvessels in the abscess walls with secondary hæmorrhage.

Hilton's method is used where important vessels and nerves might be endangered by the knife. The incision goes only through the skin. Then a probe is pushed through the deep fascia and a pair of sinus forceps is made to follow. These are opened on withdrawal to enlarge the opening.

Chronic Abscess.—A collection of pus which forms slowly and without the signs of acute inflammation.

Causes.—Those of chronic inflammation, particularly tuberculosis in connexion with disease of bones, joints or lymphatic glands.

Pathology.—The abscess wall is composed of organized fibrous tissue, and often contains vessels more or less obliterated by proliferation of their coats (endarteritis obliterans). The pus often contains caseous material.

Signs and Symptoms.—(1) No fever unless secondary infection occurs. (2) Painless fluctuating swelling

often at a distance from the primary focus, which is therefore very liable to be overlooked. (3) Evidence of constitutional disease elsewhere—*e.g.*, stigmata of syphilis, tuberculosis of viscera, etc.

Treatment.—1. General measures to overcome the constitutional disease: (a) Fresh air, sunlight, good food; (b) drugs—*e.g.*, arsenic, potassium iodide and mercury in syphilis; (c) specific therapy—*e.g.*, tuberculin.

2. Local: The object is to avoid secondary infection at all costs. If left to themselves, these abscesses often burst through the skin and secondary infection with skin organisms such as *Staphylococcus aureus* is then inevitable. To minimize this danger treat by: (a) Repeated aspiration with or without injection of chemicals and under rigid aseptic conditions. (b) Opening the abscess, scraping the wall, treatment by chemicals such as B.I.P.P. and resuture. (c) Complete removal of the abscess and its source (*e.g.*, tuberculous abscess arising in lymph nodes).

Results of Prolonged Suppuration—Hectic Fever.—In this condition there is a daily rise of temperature, usually during afternoon or evening, accompanied by a sense of well-being, during which the face is flushed (hectic flush), the eyes bright and the pulse rapid, small and compressible. In the early morning the temperature falls rapidly, profuse perspiration occurs, and is followed by exhaustion. The patient becomes progressively more anæmic and wasted.

Waxy or Lardaceous Disease (Amyloid Disease).—A waxy material is deposited in the walls of vessels and in the connective tissue of certain viscera, especially the liver, kidneys, spleen and intestines. This material stains brown with iodine and red with methyl violet (unlike normal tissues, which stain blue).

Clinically it manifests itself by: (1) Painless, uniform enlargement of the liver with impairment of digestion and of absorption, especially of fats. (2) Diarrhoea. (3) Urine at first abundant, pale, of low specific gravity and containing hyaline casts—later, it is scanty, of high specific gravity and contains albumen.

Sinus and Fistula—Definition.—A sinus is a narrow track lined with granulations and open at one end only. A fistula is a narrow track open at both ends and either leading from one cavity to another or from a cavity to the surface.

Causes.—(1) Presence of foreign body or dead unabsorbable tissue—drainage tube, silk, dead bone. (2) Irritating discharges—faeces or urine. (3) Insufficient drainage. (4) Induration of walls due to rigid structures or fibrous tissue. (5) Constant movement. (6) Downgrowth of epithelium. (7) Specific infections—*e.g.*, tuberculosis. (8) Malignant disease. (9) General debility.

Treatment.—(1) Remove the cause. (2) Excision of tracks, followed either by suture or free drainage. (3) Rest. (4) Treatment of the track—curettage, chemicals such as hypertonic saline, zinc ionization, diathermy, ultra-violet light, X-rays and radium. (5) Vaccine therapy.

CHAPTER III

NON-SPECIFIC INFECTIONS

Infection.—The invasion of living tissues by pathogenic bacteria in sufficient numbers to produce disease. This usually occurs through wounds or abrasions, either of skin or mucous membranes, particularly when the resistance of the individual is lowered by (a) general causes, such as exposure to wet or cold, starvation, previous infection, and constitutional disease (diabetes, chronic nephritis, alcoholism); or (b) local causes such as injury or defective circulation.

The results of infection depend upon the virulence of the organism and the resistance of the invaded tissue. The latter results from (1) local tissue changes and (2) changes in the blood stream and body generally. Some tissues—*e.g.*, lymphoid and vascular connective tissue—are much more capable of dealing with infection than others—*e.g.*, adipose tissue and cartilage.

Concentration* of leucocytes occurs at the site of infection, and these cells, aided by the connective tissue cells, ingest and destroy bacteria (phagocytosis). Bacterial toxins are absorbed into the circulation and stimulate an increased production of leucocytes (leucocytosis) and also the formation of chemical bodies in the blood plasma known as antitoxins, which neutralize the toxins. *Pari passu* the serum develops opsonins which render bacteria more susceptible to ingestion by phagocytes, and agglutinins which cause the clumping of organisms.

Immunity.—Is a condition of insusceptibility to pathogenic organisms which may be natural or acquired. Natural immunity may be racial or individual; acquired immunity may be active or passive.

Active Immunity may be produced in several ways:

1. A previous attack of the disease.
2. Injection of the living organisms in small doses.
3. Injection of the dead organisms.
4. Injection of the toxic products of the organisms.
5. Injection of the living but attenuated organisms.

Passive Immunity is conferred by injection of the blood serum either of another individual who has recovered from the disease, or of an animal in which active immunity has been produced by one of the methods detailed above. Such sera are termed antitoxic when produced by the injection of toxins (tetanus and diphtheria), antibacterial when the actual organisms have been used for their production.

Passive immunity is transient, but if conferred soon after infection has occurred, may be of the greatest value. Antitetanic serum (A.T.S.) and antigasgangrene serum are usually employed prophylactically in the treatment of lacerated wounds incurred in street accidents, and after gunshot wounds, etc.

Therapeutic Sera.—1. *Antitoxic Sera.*—Antitetanic, antidiphtheric, antigasgangrene, antidysenteric.

2. *Antibacterial Sera.*—Antistreptococcal (polyvalent), antianthrax (Sclavo's), antipneumococcal (Fulton), antimeningococcal.

Immuno-Transfusion—*i.e.*, the intravenous injection of defibrinated blood from a donor who has received

a large dose of dead organisms a few hours previously—is sometimes of value in the treatment of infection.

Bacterial Vaccines are sterilized cultures of pathogenic organisms which are usually injected subcutaneously or intramuscularly to produce active immunity. If prepared from a number of slightly different strains of organisms of the same species they are termed *polyvalent*; if from organisms isolated from previous cases of the disease—*stock vaccines*. Usually the most effective vaccine is prepared from a pure culture of the causal organism isolated from the patient; this is termed an *autogenous vaccine*.

Detoxicated Vaccines are prepared by dissolving the bacteria in alkali, precipitating the bacterial bodies by acid and leaving endotoxins in solution.

Sensitized Vaccines are made from bacteria treated with their own specific antiserum.

Bacteria met with in Surgical Infections—1. *Staphylococcus pyogenes aureus, albus and citreus*.—Commonly present on skin and mucous membranes. They give rise to boils, carbuncles and subcutaneous abscesses.

2. *Streptococcus pyogenes*.—Widely distributed and the cause of spreading inflammations such as erysipelas, cellulitis, lymphangitis and lymphadenitis. Two main varieties, one of which produces hæmolysis (hæmolytic streptococcus) and is extremely virulent; the other less so as a rule (non-hæmolytic streptococcus).

3. *Gonococcus*.—A diplococcus causing gonorrhœa and found either in the epithelial cells or in leucocytes in (a) urethritis, (b) vulvo-vaginitis, and (c) pelvic peritonitis.

4. *Pneumococcus*.—A diplococcus (types 1 to 4 distinguished by immune sera) present in large numbers in sputum of lobar pneumonia. Also a cause of empyema, endocarditis, pericarditis, meningitis, peritonitis, arthritis and osteomyelitis.

5. *Bacterium coli communis*.—A normal inhabitant of the intestine, capable of invading the bowel when its vitality is lowered, and often the causal organism in (a) appendicitis, (b) peritonitis, (c) cystitis and pyelitis, (d) cholecystitis, (e) ischio-rectal abscess.

6. *Bacterium typhosum*.—The cause of typhoid fever,

during which*it may be found in blood, urine, and faeces. Later it may determine (a) bone abscesses, (b) arthritis of spine (typhoid spine), (c) cystitis, and (d) cholecystitis. Some individuals harbour the organism for years in the gall-bladder and urinary tract and are liable to be the cause of further outbreaks (*typhoid carriers*).

Chemotherapy.—One of the greatest advances in modern therapeutics has been the discovery of the value of certain drugs in the treatment of infection. Valuable as these remedies are both in the prophylaxis and treatment of bacterial infections, it is important to remember that other established methods should be employed with these drugs—*e.g.*, pus should be evacuated and specific antisera administered.

Drugs.—These belong to the sulphonamide group. The three employed most are sulphanilamide, sulphapyridine and sulphathiazole. Some organisms are more susceptible to one drug than to the others, and it is therefore sometimes advisable to change from one to another.

Administration.—As a rule a large initial dose is indicated in order rapidly to obtain sufficient concentration in the blood. The end aimed at is 10 mgm. per cent., and if possible this should be checked by estimation of the blood concentration a few hours after beginning treatment.

This level must be maintained night and day throughout treatment. It is usual to give the drug by mouth, a method which has the advantage of slow, continuous absorption. If nausea or vomiting prevents oral administration, or when immediate treatment is urgent, intramuscular or intravenous injection of some soluble preparation is indicated. Excretion is rapid and frequent injections are necessary.

Local application to wounds is of value, acting both locally and by slow absorption. It is recommended that 5 to 15 grammes of sulphanilamide or sulphapyridine should be packed into war wounds at the time of excision; the earlier the application the more effective the prophylaxis.

The duration of treatment varies with each case.

Accn. No. _____ Date _____

In two to three days an improvement should be noticed, but it may be necessary to continue for ten days. *It is useless and dangerous to continue longer than this*, since fatal agranulocytosis, severe anæmia and nephritis may result. An interval of three days should elapse before commencing a second course, when it may be preferable to employ another drug in the series.

During treatment ample fluid should be administered, and if dangerous symptoms due to the drug arise at any stage diuresis should be encouraged.

Choice of Drug—Sulphanilamide.—Effective against most β -hæmolytic streptococci, meningococcus, gonococcus, *Bact. coli* and *Cl. welchii*. Little action against staphylococcus. No effect on pneumococcus and *Str. viridans*. Well tolerated by mouth, 1 gramme per 20 pounds of body weight (maximum 6 grms. daily) is given for the first two days, in equally-divided doses four-hourly night and day. The dose should be reduced by 1 gramme every two days until 3 grammes daily is reached.

Children need a 50 per cent. larger dose in proportion to body weight than adults.

Sulphapyridine (M. and B. 693).—This is effective against the same organisms as is sulphanilamide, and in addition against pneumococcus, staphylococcus, *Str. viridans* and *V. septique*. The dosage is the same as for the above. The tablets should be crushed and suspended in milk, as this tends to prevent nausea and vomiting.

Sulphathiazole.—Has an action similar to sulphapyridine, but, being more soluble, is more readily absorbed. It should be used in pneumococcal and staphylococcal cases when a course of sulphapyridine has not been effective.

For parenteral administration the best preparation is the soluble sodium salt of sulphapyridine, in ampoules of 3 c.c., each containing 1 gramme, which may be given intravenously or intramuscularly, in the former case diluted with 20 c.c. of saline.

Boil or Furuncle.—A localized inflammation of the skin, especially in parts exposed to friction.

usually due to *Staphylococcus pyogenes*, begins in a hair follicle, sweat or sebaceous gland, and ends in suppuration or sloughing.

Signs.—A small red indurated area appears, often with great pain and tenderness. The centre becomes yellow and later bursts, discharging pus and a small slough. Healing by granulation follows. In some cases a succession of boils appears in the immediate vicinity or more remotely (furunculosis).

Treatment.—‘Antiphlogistine’ or a paste of exsiccated magnesium sulphate and glycerine ($2\frac{1}{2} : 1\frac{1}{2}$) is the best local application. Incision is advisable after pus has formed. Fomentations are to be avoided, as they tend to cause fresh crops of boils. Pure air, ultra-violet light therapy, certain preparations of manganese and tin, and autogenous vaccines may prove helpful in some cases.

Carbuncle.—A localized infective gangrene of the subcutaneous tissues, usually due to *Staphylococcus pyogenes aureus*. Predisposing causes are lowered vitality from diabetes, albuminuria, or specific fevers.

Signs.—The disease begins as an infiltration of an area of subcutaneous tissue, which is hard, painful, and tender, and the skin over it red and hot. The infiltration may extend until it is the size of a dinner-plate, and ends in sloughing and suppuration, not only of the subcutaneous tissues, but of portions of the overlying skin, so that openings develop and allow of the exit of pus and sloughs. These openings extend, the sloughs separate, and the wound heals by granulation. The back is a common situation. Sometimes the face is affected, and there is then danger of thrombosis extending to the cavernous sinus, producing meningitis or pyæmia. Toxæmia is usually very marked, septicæmia rarely occurs.

Prognosis is serious if there is albuminuria or diabetes, or when the face is the site affected.

Treatment—General.—Good food with ample vitamin content, abundant fluids and fruit, fresh air and sunshine; insulin and dieting, if diabetes is present. Staphylococcal serum (20 c.c. intramuscu-

larly) or staphylococcal toxoid may be tried. Chemotherapy is sometimes of value, sulphapyridine or sulphathiazole being employed.

Local.—Antiphlogistine or a paste of magnesium sulphate and glycerine should be applied. Short-wave diathermy is a valuable adjunct. If the condition tends to spread, a crucial incision should be made extending to the limits of the indurated area and the flaps gently retracted. Sloughs are removed and the cavity packed with gauze for forty-eight hours. Hypertonic saline dressings promote healing and infra-red rays are also of value.

Cellulitis.—A diffuse spreading inflammation in the subcutaneous and cellular tissues which may end in suppuration, sloughing or gangrene.

Causes.—The exciting cause is usually *Streptococcus pyogenes*. The source of infection is (a) some accidental wound such as a prick, scratch, graze, operation wound; or (b) spread from a deep-seated focus, particularly when the resistance is lowered.

Signs and Symptoms.—(a) Affected part is swollen, tender and hot; later brawny induration and redness appear. (b) Throbbing pain is a prominent symptom. (c) Fever or pyrexia and sometimes rigors. In severe cases the temperature may be subnormal. (d) Fluctuation can be detected later, and may be followed by sloughing of the skin or deeper structures, septicæmia or pyæmia. (See later.)

Treatment.—(a) Multiple incisions exposing the whole area and ensuring free drainage of all pockets. (b) Frequent hot baths and fomentations to the affected part. Avoid excessive moist heat. (c) Passive hyperæmia. (d) Polyvalent antistreptococcal serum. (e) General measures to combat toxæmia.

Special Situations.—1. Cellulitis of the Scalp is usually due to a wound which communicates with the loose layer beneath the occipito-frontalis aponeurosis. The pus localized by the aponeurotic attachment points over the eyebrow, zygoma or superior curved line. Thrombosis may extend into the cranium through emissary veins and necrosis of the skull may follow.

2. **Cellulitis of the Orbit** results from perforating wounds, and inflammation may spread through the sphenoidal fissure to the meninges.

Panophthalmitis may occur. If the eye escapes, the optic nerve may atrophy afterwards from the pressure of contracting fibrous tissue, or the movements of the eye may be interfered with by the damage to the muscles. Free incisions must be made and drainage carried out. Fomentations form the best dressing. If panophthalmitis occurs, a crucial incision must be made in the eyeball. Enucleation increases the danger of meningitis.

3. **Cellulitis of the Neck** is usually secondary to infection from the mouth or throat and preceded by inflammation of the cervical lymph glands (lymphadenitis). Constitutional disturbance is severe and the affected part of the neck is hard and brawny. There are two special dangers: (a) Spread of cellulitis to the mediastinal tissues, and pericarditis; (b) oedema of the glottis.

Ludwig's Angina is a special form affecting the submaxillary region.

Treatment consists in early incision. Hilton's method may be used. On no account should a general anæsthetic be given, as the danger of obstruction to respiration from oedema of the glottis, which may be unsuspected, is great.

Septicæmia.—An acute general infection due to the growth of organisms in the blood stream. *Streptococcus hæmolyticus* of various strains and *Str. viridans*, *Staphylococcus aureus* and *Staph. albus*, *Cl. welchii*, meningococcus, pneumococcus, gonococcus and *Bact. coli* are among the commoner causes. Infection often occurs through a prick, scratch, or abrasion, or through an operation wound. It may also arise during the course of cellulitis or any of the varieties of gangrene.

Symptoms.—(a) Rigor is often the earliest. (b) Fever. The temperature often reaches 104° F. and remains high with slight remissions. (c) Delirium or coma. (d) Diarrhoea, which may be blood-stained. (e) Petechial hæmorrhages into the skin. (f) Local signs.

may be absent or slight. In fatal cases the temperature becomes subnormal while the pulse rises.

Diagnosis.—This is established by a positive blood culture. From septic traumatic fever (sapræmia) it is known by the fact that opening up and draining the wound makes no difference to the condition, whereas in sapræmia the patient gets rapidly better. From pyæmia, by the fact that there are neither repeated rigors nor secondary abscesses.

Prognosis is always grave, particularly when due to *staphylococcus* or *Cl. welchii* infection.

Treatment.—(a) **Chemotherapy** by a suitable member of the sulphonamide group should be instituted at the earliest moment (see p. 15); (b) general measures to increase the patient's resistance; (c) anti-streptococcal serum in large doses, intramuscularly and intravenously; (d) transfusion with normal or immunized blood.

Pyæmia.—An acute infection characterized by rigors, marked intermittent fever and the development of secondary abscesses. The organisms present are usually staphylococci, streptococci, less commonly pneumococci, gonococci, *Bact. typhosum*.

Causes.—Any condition which leads to the formation and detachment of infective emboli in the circulation. Two common examples are septic thrombosis of a vein and malignant endocarditis. In acute osteomyelitis, particles of thrombus carrying cocci are commonly detached and cause pyæmia. Middle-ear disease sometimes causes septic thrombosis of the lateral sinus and pyæmia.

An infective embolus lodges in some vessel which is too small to allow it to pass: if from a systemic vein, the lung; if from one of the portal system, the liver. A thrombus forms upon it and the organisms set up a secondary abscess. In the lungs these form wedge-shaped areas, with the base to the surface of the lung, and are called infarcts. Similar emboli may lodge and form abscesses in any of the organs, serous membranes, joints, etc. If the primary focus is in the portal area and the emboli are first lodged in the liver, the condition is called *pylephlebitis*.

In some cases pyæmia is associated with septicæmia.

Symptoms—Acute Pyæmia.—Severe rigors repeated at intervals of one to two days. The rigors last twenty to forty minutes, the temperature rises to 103° or 104° F., and remains so for about an hour, then falls rapidly, accompanied by profuse sweating. Abscesses appear in the lungs, joints, etc., and jaundice may supervene. The pulse becomes rapid and weak, the appetite fails and delirium may follow. Infective endocarditis may occur.

Secondary abscesses, which appear at the end of the first week, mature very rapidly, and there may be little evidence of any barrier of granulation tissue around them.

Chronic Pyæmia.—Fever is not well marked and the abscesses, unless in important structures, are not dangerous. These cases can go on for many months or years and yet may recover completely.

Diagnosis.—No mistake can be made when a focus of infection is apparent. If such cannot be found, pyæmia may be mistaken for malaria.

Prognosis.—This is grave in acute cases, many dying in eight to ten days. Chronic cases are favourable if the abscesses are in situations permitting of access for drainage.

Treatment—General.—Good feeding, stimulants, chemotherapy. Serum therapy, depending upon the organism. Vaccines, preferably autogenous. Blood transfusions. Immuno-transfusions.

Local.—As most cases are due to septic phlebitis, the vein should be ligatured nearer to the heart, if possible, to prevent further invasion of the blood stream. This is done in the internal jugular vein for lateral sinus pyæmia. Sometimes amputation is necessary to get above the lesion. The secondary abscesses should be opened freely and drained. Joints distended with pus may recover with free mobility under early treatment by aspiration.

CHAPTER IV

SURGICAL INFECTIVE DISEASES

Erysipelas.—A contagious infective disease, the primary lesion being usually in the skin, occasionally in a mucous membrane. There is a marked tendency to spontaneous recovery without loss of tissue, and in the ordinary facial or idiopathic variety a great tendency to recurrence.

Causes.—(a) A wound or abrasion; (b) lowered resistance, especially from a previous attack; (c) bad hygienic surroundings, especially overcrowding; (d) *Streptococcus hæmolyticus*. In facial erysipelas the source of entry can seldom be found. The streptococcus spreads in the cutaneous lymphatic vessels, and can be found just beyond the margin of the red area, while at the margin itself are found leucocytes as well as cocci. In the centre of the red area only leucocytes are found.

Symptoms.—Premonitory symptoms are malaise, headache, loss of appetite, shivering, and some pain about the wound. With these occur pyrexia, a rapid pulse, foul tongue, thirst, constipation, and scanty urine. Within twenty-four hours a crimson flush appears around the wound. The red area is swollen, spreads along the skin and has a distinct raised edge. There is a sensation of stiffness and burning. Pain is not severe unless tense structures are involved. Great swelling only occurs in lax tissues, as the eyelid and scrotum. Bullæ may appear, but suppuration is rare. The glands are always enlarged. Fever is continuous, up to 104° F., for about six to eight days; then symptoms rapidly disappear, the redness and swelling subside, and slight desquamation occurs. In bad cases the temperature remains high, delirium is severe, and the patient dies of exhaustion.

Cellulo-Cutaneous Erysipelas combines the features of erysipelas and cellulitis, being due to simultaneous infection of the skin and subcutaneous tissues by *Streptococcus hæmolyticus*.

Diagnosis.—The bright red colour and the sharply

defined raised margin are characteristic features. The *exanthemata* are never limited to one part of the body. *Lymphangitis* is characterized by red streaks. A septic wound may have redness around it, but the definite edge is not present. *Erythema nodosum* generally involves both legs in young women, and is not infiltrated like erysipelas. *Erythema solare*, or sun-burn, is limited to parts normally unexposed which have been acted on by sun-rays. It does not spread. *Eczema rubrum* has a viscid, clear exudation from the surface.

Prognosis.—Death is not likely to occur unless complications such as meningitis, pneumonia, nephritis, pyæmia, or septicæmia arise. It is more dangerous in infants and old people, drunkards, diabetics and those suffering from Bright's disease.

Treatment—Prophylaxis.—Secure the asepsis of all wounds. All cases should be isolated.

General.—Good food and stimulants. Chemotherapy should be employed and sulphanilamide is recommended. Antistreptococcal serum 50 to 100 c.c. daily is sometimes of value.

Local.—Measures designed to localize the infection such as painting around the affected area with iodine or silver nitrate solution may be tried, but are of little avail. In most cases the application of lead and opium lotion relieves the stiffness and burning and is all that is necessary. The treatment of cellulocutaneous erysipelas is that of cellulitis.

Tetanus.—An infective disease of wounds due to the *Cl. tetani*, characterized by painful tonic contractions of the muscles with convulsive exacerbations.

Causes.—A hot climate favours the growth and virulence of *Cl. tetani* in soil. Occupation such as that of a gardener makes a person who has a wound more liable to infection. Wounds incurred in street accidents, from toy pistols, and in warfare, involving contamination of lacerated and devitalized tissues by organic filth richly infected with anaerobes, are very prone to become infected with this organism if neglected.

The bacilli are usually present in garden and field

soil and dust. In artificial cultures a spore forms at one end, giving the bacillus the characteristic 'drum-stick' shape. The bacilli are anaerobic, and cannot grow in the tissues unless pyogenic organisms are present to use up the oxygen and thus provide for them an oxygen-free atmosphere. The bacilli do not spread widely, but manufacture their toxins *in situ*. The toxin is now believed to travel by the nerves to the brain and cord, not by the blood.

Symptoms.—The incubation period may be as short as a few hours or as long as several weeks (cases modified by prophylactic doses of antitetanic serum generally), but usually it is five to fifteen days. The earliest symptoms may be *general*—*e.g.*, insomnia, irritability, increased reflex excitability, etc.; or *local*, with pain in the wound region and twitchings of neighbouring muscles. Later, sore throat, dysphagia, stiffness of neck and jaws (*trismus*), and finally of the face (*risus sardonius*) may occur. Contraction of trunk muscles follows, producing either *opisthotonos* when the body is arched backwards, *emprosthotonos* when it is arched forward, or *pleurosthotonos* if bent to one side. Contraction of the limb muscles follows. The muscles of respiration are affected last of all. The characteristic feature is that the spasm is never quite relaxed, and the slightest stimulus—*e.g.*, a noise or a bright light—may induce violent tonic contractions strong enough to rupture muscles or break bones. The pulse is rapid, the temperature generally raised, and sweating excessive. Consciousness is unimpaired until the end. Death results as a rule from toxæmia and exhaustion, or from asphyxia following a prolonged spasm. Cases in which the incubation period is prolonged (*delayed tetanus*) are generally milder, convulsions are fewer and less generalized, and the mortality is lower, but exceptions occur, and such cases may be rapidly fatal. A special variety called *head tetanus* seems to affect mainly the muscles of the head and neck, and is often associated with facial paralysis. Other varieties are acute, local, operative (due to catgut), 'Fourth of July,' 'tetanus hydrophobius,' 'tetanus neonatorum.'

Diagnosis.—From *simple trismus*, due to dental irritation or arthritis of the temporo-mandibular joint, by the fact that in tetanus there is also rigidity in the neck muscles. From *strychnine poisoning*, by the fact that in tetanus there is no complete relaxation between the spasms, and the hands are rarely involved. In *hydrophobia* the contractions are never tonic. In *tetany* there are characteristic carpo-pedal deformities, but no generalized spasm.

Prognosis.—This is grave, but in general the longer the incubation period the more localized the spasm, and the longer the case lives the better the outlook. Another feature to consider is whether the patient has had prophylactic treatment, as cases which supervene in spite of this are often mild.

Prophylaxis.—Protection against a subsequent attack of tetanus is provided by a series of injections of tetanus toxoid (alum-precipitated); 1 c.c. is injected subcutaneously on three occasions at intervals of six to twelve weeks and active immunity* results. For a period of five years after this an injection of toxoid will raise the antitoxin in the blood rapidly to an extent which obviates the giving of antitoxin.

Treatment.—Excision and free drainage of infected wounds, and the use of preventive doses of *antitetanic* serum. It is usual to give a dose of 1,000 to 3,000 International (=500 to 1,500 U.S.A.) units subcutaneously as soon as possible, followed by three doses of 1,000 units at weekly intervals. These doses are to be modified if the nature of the wound demands it.

When the disease is established it is doubtful whether any local operative measures, except to secure drainage and remove dead tissue, are justified.

1. **General Treatment.**—A quiet darkened room at an even temperature is essential, and external stimuli should be reduced to a minimum. Abundant concentrated liquid food should be given by mouth and, failing this, by rectum.

2. **Sedatives and Anæsthetics.**—Avertin (0.1 gramme per kg. body weight) is the most useful. Chloral hydrate, potassium bromide, and morphine are also used. They serve to diminish the excitability of the

patient. Chloroform on a mask may be required to control the actual spasms. Curare is still under trial.

3. **Tetanus Antitoxin.**—Although there is some doubt as to the efficiency of antitoxin in established tetanus, the consensus of opinion is in favour of its use. In general, it is desirable to give it as soon as the slightest suspicion of tetanus is entertained, to give it in large doses, and to continue it into convalescence. The routes recommended are: (a) Intravenous, (b) intramuscular, (c) subcutaneous, approximately in order of efficiency; 50,000 to 100,000 units should be given in the first forty-eight hours, followed by daily gradually diminishing doses. Intrathecal antitoxin is not recommended.

Hydrophobia or Rabies.—An acute general infective disease communicated through the saliva of rabid dogs to man, either by a bite or by the animal licking an abraded surface. The incubation period varies greatly, but is usually six weeks. The disease is ushered in by a vague sense of terror, delusions, and hallucinations. Restlessness, sleeplessness, loss of appetite, and repugnance to fluids follow. The characteristic symptoms are convulsions and stiffness in the muscles of deglutition and respiration. These are clonic in character, never tonic, and are brought on by any slight stimulus. Swallowing is impossible, and the mouth becomes filled with ropy mucus. The respirations become jerky from spasm of the diaphragm. Convulsions become general and the patient dies from exhaustion of the medullary centres, or exceptionally from spasm of the glottis. Death occurs in two to seven days.

Treatment—Prophylaxis.—Freely excise the region of the bite or abrasion and purify with strong carbolic acid or other caustic.

Pasteur's treatment should be started as soon as possible. This consists of injection of attenuated virus (from rabbit spinal cords) in increasing doses and increasing strength. By this means the disease can be prevented, provided treatment is commenced soon after exposure to infection.

Palliative treatment, once the disease is established,

consists in keeping the patient in a quiet room, giving chloral, hyoscine or morphine and chloroform for the spasms, good feeding and stimulants.

Anthrax.—Is due to infection with *Bacillus anthracis*. If inoculated through the skin, malignant pustule or anthrax œdema is produced; if *via* the lungs or intestinal mucous membrane, 'woolsorters' disease' or anthracæmia results.

Infection occurs amongst people who have to deal with living diseased animals, such as graziers and butchers, or people who work in hides and wool. Cases have occurred from the use of infected shaving brushes.

Malignant Pustule commences as a red pimple at the site of inoculation, which spreads rapidly with much infiltration. The central part is at first vesicular, but rapidly becomes a black slough, surrounded by a ring of vesicles, which contain the bacilli. The nearest lymphatic glands are enlarged. Fever and malaise are not pronounced until the fifth day. Pulse and temperature then increase and vomiting often occurs. The patient dies from toxæmia in about a week from the onset in unfavourable cases. Usually the process remains limited, and no general infection occurs; the slough separates, and healing by granulation follows.

Anthrax Œdema is a form which is usually rapidly fatal, affecting the face and neck. Acute cellulitis develops, with brawny induration and massive œdema, which is followed by gangrene.

Woolsorters' Disease takes either the form of pleuropneumonia, and runs a rapidly fatal course, or that of gastro-enteritis, which is grave but not so often fatal as the pulmonary form.

Treatment of malignant pustule consists in excising freely the necrotic area, and applying pure carbolic acid or cautery. Sclavo's serum, 30 to 50 c.c., injected intravenously and repeated daily for three days, has given good results even without local excision. Sobernheim's serum is also used with success. Intravenous N.A.B. has its advocates.

In anthrax œdema and woolsorters' disease treat-

ment is restricted to general measures and serum therapy; it is seldom successful.

Gonorrhœa.—An infective disease due to the *Gonococcus* and characterized by a purulent discharge from the urethra. Sexual connexion with an infected person is the usual mode of infection. The cocci are found in pairs in the epithelial cells and pus corpuscles of the discharge. Infection occurs through invasion of the epithelial lining of the urethra. The organisms stain with aniline dyes, but are decolorized by Gram's method.

Symptoms.—Discharge begins two to eight days after infection, preceded for some hours by scalding pain during micturition. The discharge, at first thin, soon becomes thick and yellow. Congestion of the mucous membrane of the urethra is occasionally, though rarely, sufficient to cause retention of urine or hæmorrhage. In some cases, if properly treated, recovery occurs in two to three weeks; if neglected, and sometimes in spite of treatment, *Posterior Urethritis* occurs, characterized by frequent and painful micturition, and perhaps extension of inflammation to the prostate and testis.

Chronic Gonorrhœa, or Gleet, commonly remains in these cases, and is due to: (a) Infected urethral glands or submucous infiltration, which can be seen with the urethroscope; (b) chronic prostatitis and vesiculitis. It may be followed by stricture of the urethra.

Diagnosis is made by: (a) Smears stained by Gram's or Leishman's method; (b) cultures on moist blood agar; (c) complement fixation test which is usually positive if the posterior urethra is affected, and of no value if negative or if gonococcal vaccines have been used previously. The reaction persists for one to two months after the cocci have disappeared from the discharge.

Prophylaxis.—As soon after exposure as possible the penis, especially the frænum and the lips of the meatus, should be washed with soap and water, followed by potassium permanganate 1 in 2,000.

Treatment: 1. *Acute Gonorrhœa—General.*—Lessen the acidity of the urine by alkalies, give diuretics, and

keep the bowels acting freely. Sedatives such as tinct. hyoscyami are useful. All forms of alcohol should be forbidden and plenty of fluid taken. The patient should rest as much as possible.

Local.—Irrigation of the urethra and the bladder with a solution of potassium permanganate, commencing with 1 in 5,000 and working up to 1 in 2,000. The patient micturates and the fluid is then run in from a receiver by rubber tubing and a glass cannula inserted into the meatus, using 2 feet of pressure, two or three times a day. After a few days the pressure is raised to 3 to 4 feet and the patient is instructed to attempt to micturate while the fluid is running in. This relaxes the compressor urethræ, and the posterior urethra and bladder will then be irrigated. In addition, at the end of ten to fourteen days, massage of the prostate and vesiculæ is started.

Chemotherapy.—A course of sulphapyridine should be commenced after ten days of local treatment. In some clinics chemotherapy is started on the first day and continued for three weeks. The consensus of opinion is against this practice, as the percentage of relapses appears to be higher than when chemotherapy is delayed for one to two weeks.

2. *Chronic Gonorrhœa.* — 1. The first step is to diagnose the seat and extent of the disease. For this purpose the urethroscope is invaluable and may disclose granular patches, polypoid areas, ulceration, changes in colour of the mucous membrane due to sclerosis, a commencing stricture, or chronic infection of Littre's glands.

2. Topical applications of solutions of silver nitrate up to 5 per cent.

3. Dilatation of the urethra with Kollmann's dilator or sounds.

4. Irrigation with potassium permanganate 1 in 2,000 or silver nitrate 2 grains to 1 ounce.

5. Massage of prostate and vesicles.

6. General measures. Light diet. Avoidance of exercise and alcohol. No sexual intercourse.

7. Vaccines, preferably autogenous. An initial dose of 5,000,000, increasing at weekly intervals. Later

a mixed vaccine to combat secondary⁶ infection with pyogenic organisms.

8. Diathermy to the prostate.

9. Chemotherapy is now universally employed in conjunction with one or more of the above methods.

Test of Cure.—All treatment is stopped, the patient allowed exercise and some alcohol, and instructed to hold his water overnight. Smears and cultures are made from the anterior urethra, urine, and posterior urethra (after prostatic massage). Absence of gonococci after repeating this test at an interval of a month generally means a cure.

Another method, sometimes employed if marriage is contemplated some time after an attack, is to give a provocative dose of vaccine, which will light up any latent infection.

Complications.—These arise from (1) direct extension, (2) direct transmission, (3) general absorption.

1. *Direct Extension.*—Balanitis or inflammation of the prepuce, which may lead to inguinal adenitis (bubo). Phimosis and paraphimosis may occur, as also gonorrhœal warts on the glans penis.

Lacunar Abscess occurs in the follicles of the urethra. A painful swelling forms, and the abscess bursts into the urethra or externally, or both. In the latter case a penile fistula is produced. To prevent this, the abscess should be opened early and externally.

Chordee, or painful erection, is due to inflammation of the corpus spongiosum or corpora cavernosa, the penis being bent when erections occur. Sedatives, particularly bromides, at bed-time prevent this and cold compresses relieve it.

Inflammation of Cowper's Gland may go on to suppuration. Early incision may prevent a urinary fistula.

Prostatitis, vesiculitis, epididymitis and cystitis are discussed elsewhere.

2. *Direct Transmission.*—**Gonococcal Conjunctivitis** is rare in adults. In infants (ophthalmia neonatorum) infection occurs, during birth, from the maternal vagina. The eye becomes injected and discharges first mucus then pus. There is great

œdema of the conjunctiva (chemosis). The cornea may ulcerate and the eye be disorganized.

•*Prophylaxis*.—Crédé's method: A drop of silver nitrate 1 per cent. is instilled between the lids immediately after birth and repeated in eight hours if there is any discharge.

Treatment.—In adults, if unilateral, protect the other eye by Buller's shield. The affected eye must be irrigated with boracic lotion every hour, and in addition silver nitrate, 5 to 10 grains to 1 ounce, should be dropped in after the application of cocaine.

Gonococcal Proctitis, from spread to the rectum, especially in females, is treated by irrigation with boracic lotion.

3. *General Absorption*.—*Gonococcal Arthritis* occurs in the subacute stage. Synovitis may occur or arthritis, with or without suppuration.

Gonococcal Fibrositis.—Ligaments, tendinous insertions and aponeuroses may be affected, particularly in the foot.

Rhinitis, iridocyclitis, scleritis, endocarditis, pyæmia, and septicæmia rarely occur.

Gonorrhœa in Females.—The primary lesion is in the urethra or cervix uteri, or in both, the infection being very liable to spread to the Fallopian tubes, ovaries and pelvic peritoneum, leading to sterility.

Treatment.—1. *Acute Gonorrhœa*.—0.5 gramme sulphapyridine is given five times a day at four-hourly intervals, together with sodii bicarb. 30 grains to prevent nausea. This dosage is continued for ten days. Daily vaginal douching and urethral irrigation with potass. permanganate 1:8,000 is also carried out for a period of two to three weeks, then continued every other day or at longer intervals for several weeks more.

2. *Test of Cure*.—Films and cultures from both cervix and urethra are examined just after menstruation on three occasions at monthly intervals. A provocative dose of vaccine is given before the last test.

3. *Chronic Gonorrhœa*.—Local treatment may need

to be prolonged. Urethral massage, painting of the cervix with iodized phenol, and local heat by diathermy or Elliott's machine are the main indications.

Gonorrhœa in Children.—Vulvo-vaginitis is always associated with urethritis, and in 10 per cent. the rectum is involved. A four days' course of sulphapyridine gives satisfactory results in many cases.

Syphilis.—An infective disease which may be acquired, or inherited from a syphilitic parent. The specific organism, *Treponema pallidum*, rather more than the diameter of a red blood cell in length, consists of spiral filaments, with eight to twelve regular short deep curves and pointed ends. The disease is usually divided into three stages:

1. *Primary stage.* Covers the incubation period and the primary sore, which may be multiple.

2. *Secondary stage* is that of general infection, characterized by lesions of the skin and mucous membranes.

3. *Tertiary stage*, in which visceral disease, particularly of the nervous system, and isolated lesions (gummata) occur.

Infection is almost always from sexual connexion, and the primary sore appears on the genitals. Occasionally extragenital sores occur, as on the lip, face, tonsil, finger, nipple. The discharge from the primary sore is infective, as are the blood, all pathological exudations in the secondary stage, and also the semen. Secretions, such as milk or urine, unless mixed with exudation from a lesion, are not infective. One attack usually confers immunity.

Incubation lasts from ten days to eight weeks usually four weeks.

The Primary Stage is characterized by the hard chancre, which appears on the prepuce or glans penis near the corona, or on the frænum. In the female it may be on the inner side of the labia majora or nymphæ, or on the cervix. The vaginal wall is rarely attacked. Bulky lymphatic glands in the groin with hardened lymphatics running from the sore, are characteristic. The typical hard or Hunterian chancre is a sore with a very indurated base, which

may feel as hard as a button. Rarely the lesion may take the form of a papule, which does not ulcerate. A urethral chancre just inside the meatus may occur. The glands do not suppurate unless pyogenic organisms or Ducrey's bacillus are present.

The duration of a primary sore depends upon the promptitude of treatment. Unless there are septic changes superadded, little scarring results.

Phagedena is a spreading form of ulceration which may accompany a primary sore, especially in men with phimosis. The body of the penis, and even the inguinal glands, may be destroyed if the disease is not promptly treated. All tension should be relieved by incisions followed by frequent hot baths. Alternatively the surface may be curetted and pure carbolic acid applied.

Diagnosis.—Early diagnosis is of paramount importance.

1. *Demonstration of the Organism.*—Serum from the sore is examined microscopically, under dark-ground illumination alone, or after mixing with Indian ink or staining by Romanowski's method.

2. *Wassermann Reaction (Complement Fixation Test).*—This is of little or no value for early diagnosis, as positive results do not appear until two to six weeks after the primary sore. In the later stages it is valuable if positive not only in the blood, but also in the cerebro-spinal fluid.

The Secondary Stage.—This begins usually within two months of infection and lasts about two years. It may be severe in debilitated or untreated cases, practically absent or unnoticed in others. There is some constitutional disturbance, malaise, febrile symptoms, and anæmia. The chief manifestations, however, are lesions of the skin and mucous membranes, with general glandular enlargement and thinning of the hair.

Skin Eruptions.—(1) Erythema or roseola is the simplest, due to hyperæmia. (2) Papular syphilides are infiltrated papillæ. (3) Nodular or tubercular syphilides. (4) Pustular syphilides. (5) *Rupia* is a late secondary manifestation. Ulceration occurs and

the discharge is heaped up in a crust like a limpet-shell.

Characteristics.—(1) Polymorphism and diffuseness: Several distinct types appear on different parts. (2) Rough symmetry. (3) Tendency to disappear spontaneously. (4) Absence of pain or itching. (5) Copper or raw-ham colour. (6) The lesions occur especially on the flexor aspects, front of abdomen and back, and edge of the hairy scalp. (7) Scars from rupia are thin, depressed, white, and circular, with a surrounding ring of pigmentation.

The Mucous Membranes.—*Mucous patches* are shallow ulcers which occur on the pillars of the fauces, tonsils, uvula, soft palate, tongue, inner sides of cheeks, and lips. These ulcers are shallow, with sharply cut edges and a greyish base (snail-track). They must be diagnosed from follicular tonsillitis, dental ulcers, and lupus.

Condylomata are infiltrated papillæ in situations which are always moist, as about the anus or vulva. They form soft and warty moist greyish patches, which are highly infective. Two patches usually form opposite one another if the surfaces lie naturally in contact.

The Lymphatic Glands are discrete and usually enlarged throughout the body. The state of the posterior cervical chain and of the epitrochlear glands is a useful criterion in suspicious cases.

Iritis.—Syphilis causes 50 per cent. of the total cases of iritis. There is ciliary congestion, pain, photophobia, lachrymation, discoloration of the iris, sluggish or irregular pupil, adhesion of the iris to the lens or cornea, and a deposit of yellowish nodules of lymph in the iris. Antisyphilitic treatment and atropine locally usually results in cure. If neglected, adhesions, blocked pupil, and secondary cataract occur.

Periostitis, leading to the formation of nodes, especially on the tibia.

Synovitis, which is usually symmetrical, most frequently in the knees.

Epididymitis, subacute and symmetrical, is unusual.

*Endarteritis** *obliterans*, which may be responsible for gangrene.

Choroido-retinitis is not unusual.

The Tertiary Stage.—This may be delayed for thirty years. Chronic inflammation may occur in any part of the body and be either diffuse or localized. If the latter, a gumma results, composed of small round cells, endothelial, plasma, and giant cells, and a few vessels which may be the seat of endarteritis. Necrosis of the central part often occurs, and if near the surface the skin gives way, exposing a central, dry, whitish-yellow (wash-leather) slough. Healing of a gumma is accompanied by fibrosis, leaving a cicatrix. Common situations are the skin and subcutaneous tissues, mouth, pharynx, tongue, rectum, larynx, testicle, and bones, especially of palate, nose, and cranium.

Syphilitic Ulcers result from cutaneous and subcutaneous or submucous gummata.

Characteristics.—(1) Ulcer preceded by a swelling. (2) Often multiple and later confluent. (3) Edges sharply cut, circular, or serpiginous. (4) Base covered with 'wash-leather' slough. (5) Healing leaves scars which are thin, supple, and white ('tissue paper'). There is a pigmented ring round the ulcer if it has lasted any length of time.

Syphilitic Lupus is a diffuse infiltration of the skin with hyperæmia, usually about the nasal aperture, lips, and forehead. It is very much more rapidly destructive than lupus vulgaris (see p. 121).

Visceral Disease.—Diffuse sclerosis occurs in the spinal cord (tabes) and brain (general paralysis), liver, tongue, rectum, testicle, arteries, and bones.

Prognosis.—This is good if the patient comes under treatment early and if treated thoroughly. If there is an idiosyncrasy which prevents the patient taking mercury or iodides, the prognosis is less favourable.

Prophylaxis.—It is probable that syphilis may be prevented by rubbing into the exposed parts a 30 per cent. calomel ointment within an hour of connexion.

Treatment should be started as soon as the diagnosis can be established—*i.e.*, by the discovery of the

treponema in the primary stage, and by the Wassermann later. Treatment should be continued until repeated blood tests, after provocative injections of N.A.B. or similar drug, have proved negative after cessation of treatment for six months. As a preliminary the teeth should be attended to and alcohol and tobacco restricted.

A course of treatment should be completed within three months, and at least three courses are necessary in primary and secondary syphilis, more in tertiary cases. Intravenous injection of one of the trivalent organic arsenical compounds—*e.g.*, neo-arsphenamine, novarsenobillon (N.A.B.), stabilarsan—is given at an interval of four to seven days, the first dose being 0.3 gramme, and if well tolerated increased to 0.45 gramme and then to 0.6 gramme at successive visits. Concurrently a suspension of bismuth (or mercury) is injected intramuscularly at each visit. A total of 5 grammes of arsenic compound and of 2 grammes of bismuth metal should be administered during the course.

One month should elapse between the courses, and during this interval potassium iodide 20 to 30 grains should be given three times daily.

Intolerance to arsenic is occasionally met with, the patient developing albuminuria, jaundice or dermatitis. Liberal quantities of water and a fat-free diet are indicated, together with intravenous sodium thiosulphate and intramuscular injection of liver extract. Further antisyphilitic treatment should be by bismuth or mercury and iodides.

N.B.—All arsenical, bismuth, and mercurial preparations may be dangerous in patients with renal or hepatic disease.

Local Treatment.—The primary sore should be treated vigorously by inunction with ung. hydrarg.; it can be dressed with lotio nigra. A mouth-wash of perchloride of mercury, alum, or potassium chlorate should be used in the secondary stage. Condylomata should be washed twice a day and dusted with equal parts of calomel and boric acid.

Tertiary Syphilis needs prolonged treatment. A

pentavalent arsenical compound such as tryparsamide should be employed, unless contra-indicated by visceral disturbances. Large doses of potassium or sodium iodide (30 to 50 grains or more) should be given in milk three times daily. When the cardiovascular system is affected, dosage of arsenic and bismuth should be small, and it is safer to avoid intravenous injection.

Curability.—Ninety per cent. of cases, if treated thoroughly, escape tertiary lesions. Marriage should not be permitted until all lesions have disappeared, and the Wassermann is proved persistently negative six months after all treatment has been stopped.

Congenital or Inherited Syphilis.—Syphilis may be conveyed to the ovum either by direct transmission from the father or mother, or both.

Colles's Law.—A child with inherited syphilis may infect a healthy wet-nurse, but will not infect its mother. It is practically certain that this maternal immunity is due to a previous mild and unrecognized infection.

Miscarriage is a common occurrence when the fœtus is syphilitic, owing to changes in the decidua; or a dead child is born at full term. In many cases, however, a living child is born, and may appear healthy at birth. In the first three weeks to three months symptoms appear, preceded by wasting and anæmia. The manifestations resemble those of acquired syphilis, except that there is no primary sore.

Special Features.—1. *Skin eruptions* appear early, roseolous or papular, on the buttocks, genitals, and legs. They may be bullous (pemphigus). The more coppery and the more the infiltration of the skin, the greater the likelihood of the rash being syphilitic.

2. *Mucous tubercles* about the angles of the mouth leave radiating scars, which are characteristic (rhagades). Ulceration in the mouth, on the tongue, and condylomata about the anus and in moist folds often co-exist.

3. *Catarrhal rhinitis (snuffles)* is an early sign, and may go on to ulceration and destruction of the nasal bones and cartilages, leaving the characteristic de-

pressed nasal bridge. Many die of malnutrition in the first year unless treated.

4. *Craniotabes* (unossified areas) and Parrot's nodes occur in the skull during the first two years.

5. *Periostitis and epiphysitis*, which are usually symmetrical and often multiple, affect the long bones within the first year.

6. *Permanent teeth, especially the central upper incisors, are stunted, wider at neck than at crown (peg-top), and sometimes show a notch, which is a large segment of a small circle in the cutting edge (Hutchinson's teeth).*

7. *Interstitial keratitis* occurs about puberty and usually both eyes become affected. The cornea becomes hazy (ground glass) and vascular patches (salmon patches) appear. It frequently results in corneal opacities (nebulæ).

Diagnosis.—Some lesions resemble those of rickets and tuberculosis. The points to rely on are: (1) Deep notch in permanent central incisors; (2) interstitial keratitis; (3) periostitis of tibia and nodes on the skull; (4) depressed bridge of nose and scars about the mouth, palate, and fauces; (5) enlargement of the liver; (6) history of snuffles and rashes in the child and miscarriages in the mother; (7) Wassermann reaction.

Treatment.—The child must never be suckled by a wet-nurse, or the latter will become infected. Sulpharsphenamine should be given intramuscularly and is well tolerated even by infants. Bismuth or mercury should be administered as in the acquired disease.

Soft Chancre or Chancroid.—An infective sore on the genitals due to a specific bacillus (Ducrey's). It usually begins as a papule within one to five days of infection, soon becomes a vesicle, while within four to five days it is a pustule. The ulcer left when the pustule discharges is acutely painful, and, if kept clean, it heals in about three weeks. The sores are usually seen on the corona, prepuce or vulva, but if the secretion comes into contact with other parts a similar lesion is produced.

If ulceration^{*} takes place under a long foreskin the prepuce may be perforated by sloughing. It is also occasionally found that at the end of a few weeks the sore takes on a typically indurated syphilitic character, in which case the two infections have been contracted at the same time.

The lymphatic glands in the groin become swollen and tender and may suppurate. If only pyogenic organisms are absorbed, pus is found in the gland tissue; whereas if the specific bacillus reaches the glands, not only is there suppuration, but there is ulceration due to periadenitis and a large soft chancre in the groin results.

Treatment—1. *Dmelcos Vaccine*.—Six graduated doses should be given on alternative days, commencing with 1 c.c. and increasing by 0.5 c.c. to 3 c.c.

2. *Sulphapyridine* should be given over a period of ten days.

Lymphogranuloma Inguinale.—A disease due to an unknown organism or virus which appears to gain entrance through an abrasion of the genitals. Inguinal adenitis or proctitis producing an indurated mass and rectal stricture may be the first indication. The painless^{*} character of the lesion gives rise to suspicion of syphilis or cancer. The diagnosis is confirmed by intradermal injection of an antigen from a proved case, when a papular eruption is produced. Treatment is by injections of potassium antimony tartrate.

Tuberculosis.—Tuberculosis is an infective disease due to the *Bacillus tuberculosis* (Koch), which is acid-fast when stained by the Ziehl-Neelsen method, and of which two main varieties occur, bovine and human, differing in cultural and inoculation reactions. To the former are attributed most of the surgical forms of the disease.

Etiology—1. *Inherited Predisposition*.—The children of tuberculous parents do not inherit tuberculous disease, but have less resisting power against the tubercle bacillus.

2. *Age*.—Surgical tuberculosis occurs mostly in children under the age of ten, but no age is exempt.

3. *Unhealthy Surroundings* and bad hygiene predispose.

4. *Debility* due to other diseases such as the exanthemata (scarlet fever, measles, etc.).

5. *Local Disease or Injury*.—Chronically infected tonsils or lymph glands, slight injuries to bones or joints often precede the onset of tuberculous disease.

6. *The exciting cause* (*B. tuberculosis*) may gain entry through inhalation, ingestion or inoculation. Milk from cows with tuberculous udders is often responsible.

Pathology.—Invasion by the tubercle bacillus is followed by chronic inflammation of the part, with the development of miliary tubercles, which in their typical form consist of one or more giant cells (large multinucleated cells, the nuclei being round or oval and arranged around the periphery of the cell) surrounded by a zone of ovoid endothelioid cells, and beyond this by a layer of small round cells (lymphocytes). In most cases miliary tubercles tend to coalesce and to be accompanied by formation of granulation tissue. Necrosis may occur, partly from tuberculous toxins and partly from diminished blood supply; this is termed caseation (from the cheesy appearance of the necrotic material). The caseous matter may become liquefied and form a cold abscess. This may burst through skin or mucous membrane, leaving a tuberculous ulcer, characterized by an irregular and ragged margin with undermined congested edges and oedematous granulations in the base.

Surgical tuberculosis is in most cases due to the bovine variety of the bacillus, and infection occurs through drinking milk from tuberculous cows. Common situations of the disease are lymph glands, particularly the cervical group, bones and joints, and alimentary canal. These will be dealt with under their respective headings.

Diagnosis.—There are several laboratory methods used:

1. Microscopical examination of excretions, pus or tissue removed, after staining by Ziehl-Neelsen's method, may result in finding the bacillus.

2. Microscopical examination of sections of tissue for the typical miliary tubercle.

3. Inoculation of susceptible animals such as the guinea-pig.

4. Mantoux's skin reaction. A drop of diluted tuberculin is injected intracutaneously, and the reaction is positive if a violet-red papule with characteristic regular or festooned margin develops within twenty-four to forty-eight hours.

General Treatment.—Two main objects are aimed at: (1) To increase the resisting powers of the body; and (2) to attack the lesions directly by operation. The latter may be supplemented in suitable cases by the use of—

1. Specific remedies—*e.g.*, tuberculin residuum (T.R.) prepared from human and bovine bacilli, and injected subcutaneously at intervals of ten days.

2. Hygiene, fresh air, and especially sunshine. The latter has a specific value in tuberculosis, and should be applied to the whole body, including the local lesion. Artificial substitutes for sunlight are of great value.

3. Diet should be nourishing and easily digestible. Tuberculin-tested milk and cream should be a constituent.

4. Drugs. Cod-liver oil, iron, nux vomica, and guaiacol are given.

Glanders.—Is primarily a disease of horses, asses and mules, which is transmitted to man by direct inoculation. The disease is due to *Pfeifferella mallei*, and produces swellings which break down and ulcerate.

In man, glanders may start in the hands, face, or nasal mucous membrane. In acute cases the incubation period is three to five days, followed by malaise, fever, and general pains. Swellings form at the site of inoculation, which break down and ulcerate. Similar swellings may occur in the viscera. Severe toxæmia leads to a fatal termination in seven to ten days. In chronic cases general symptoms are not so severe, and 50 per cent. recover.

Diagnosis.—From small-pox by the presence of

Pf. mallei in the discharge and by the extensive character of the pustules. Injection of mallein, a sterilized culture of the bacilli, causes a sharp febrile reaction if glanders is present; but the equally valuable complement-fixation test is safer.

Treatment.—Extirpation of the local foci before general infection occurs is the only treatment of any use.

Leprosy.—An infective disease due to the *B. lepræ*, producing localized formations of granulation tissue. It is contagious, but not highly so.

Varieties.—(1) Tuberculated; (2) anæsthetic.

Tuberculated or Cutaneous Leprosy.—Malaise and fever are first noticed, followed by shiny, red, hyperæmic spots which are infiltrated, raised and hyperæsthetic; the usual situations are the forehead, forearms, and thighs. They may disappear, but always return with febrile symptoms. After a time the patches become nodular, and may cicatrize or ulcerate. The viscera and glands may be similarly affected. Death is due after many years to sepsis, laryngeal obstruction, pulmonary or renal disease.

The bacilli are found in the large cells (lepra cells) which are scattered amongst the granulation tissue of the nodules.

Anæsthetic Leprosy.—Begins with malaise and fever, followed by pains and tenderness along the course of peripheral nerves. Muscular weakness, paralysis, alterations of sensation and trophic changes follow. Spreading yellowish-white patches appear in the skin. The ordinary changes due to destruction of nerves follow. Fingers and toes may disappear by absorption of their bones. The affected nerves can be felt as large and tender cords. General debility leads to death after many years.

Treatment is on the whole unsatisfactory, but derivatives of chaulmoogra oil have benefited many cases.

Actinomycosis.—A disease due to *Streptothrix actinomycetes*, affecting cattle and rarely man. This fungus is Gram-positive, anaerobic and acid-fast.

Man is infected by contaminated dust, pollen or

grain which gains admission as a rule by the mouth, through an abrasion, a tooth socket or the tonsil. The disease is commonest in the cervico-facial region, jaws and tongue, where it produces an indurated puckered mass with sinuses. In the lungs it tends to form cavities, and may invade the chest wall. It may also involve the ileo-cæcal region, and simulate appendicitis. Granulation tissue is formed, accompanied by suppuration and dense fibrosis. In the pus, granules of the fungus, sometimes of a yellow colour, may be found.

Diagnosis.—Must be made from tuberculosis, gumma, and breaking-down malignant growth. The presence of characteristic granules, the absence of glandular involvement and the extensive fibrosis are diagnostic points.

Treatment.—Free excision and cauterization when possible, followed by large doses of potassium iodide or iodine in milk. Vaccines have been tried, but the results are not promising. X-ray therapy is sometimes useful.

CHAPTER V

WOUNDS AND SHOCK

WOUNDS

A wound is a forcible solution of continuity involving the soft tissues. If the skin or mucous membrane is unbroken it is termed *closed*, otherwise it is *open*.

1. **Closed Wounds.**—(a) Contusion, (b) Hæmatoma.

(a) **Contusion.**—An injury of the subcutaneous tissues due to violence. Pain, swelling, and discoloration from extravasation of blood are the signs. In lax tissues, as the eyelid, scrotum and vulva, extravasation is greatest, and the part becomes black. A deep bruise may take several days in showing itself. The black colour changes to brown, green and yellow before it disappears. The colour is due to changes in the pigment of the red corpuscles.

When the blood is not distributed through the tissues, but collected in a fluid swelling, it is called a hæmatoma.

(b) **Hæmatoma.**—This resembles an abscess in being fluid, but differs from it in that it immediately follows some injury, is not preceded by signs of inflammation, and there are sometimes signs of bruising around it. A deposit of fibrin can generally be felt at the periphery of the swelling. The subsequent history is either that (1) the whole swelling becomes absorbed; (2) the fluid part is absorbed and the fibrinous part converted into scar tissue; (3) a cyst containing serous fluid is left; or (4) suppuration occurs by infection from without or from within (auto-infection).

Treatment.—Application of cold lotions, pressure, and keeping the part at rest. Evacuation is only necessary when there is much pain or absorption is delayed.

2. **Open Wounds.**—Are divided into *incised*, *punctured*, *lacerated* and *gunshot* wounds.

(a) **Incised Wounds.**—Are made by sharp-cutting instruments. Hæmorrhage is free, the wound gapes, and bruising of the margins is absent. Operation wounds belong to this variety.

Treatment—1. *Arrest of Hæmorrhage.*—Capillary bleeding ceases spontaneously. Arteries and veins are secured by pressure forceps, followed by torsion or ligature.

2. *Sterilization of the Wound.*—In accident cases the surrounding skin should be shaved, scrubbed with a nail-brush and soap, and dried with ether or surgical spirit.

3. *Apposition of Surfaces.*—If the wound is clean, buried absorbable sutures of catgut should be used. Skin edges are brought together by sutures of silk-worm gut, horsehair, silk or metal clips (Michel's), and if there is much tension on the edges, deeper and wider stitches are also inserted (tension sutures).

4. *Drainage.*—Must be provided for in the event of persistent oozing or doubt as to the sterility of the wound. A rubber drainage tube or a strip of corrugated rubber answers best.

5. *Aseptic* (sterilized) *dressings* are applied.

6. *Rest* to the part and attention to the *general health* are necessary.

In aseptic incised wounds, skin sutures may be removed in seven days. In the face they should be taken out in two to five days to prevent scarring.

If a wound becomes septic, free drainage must be provided by removal of stitches and the treatment for acute inflammation (see p. 8) instituted.

(b) **Punctured Wounds.**—May appear trivial owing to the small external opening, but special care is essential to exclude injury to underlying structures, such as arteries, nerves, tendons, viscera, and serous cavities, and the presence of a foreign body.

Treatment.—If in doubt, the wound should always be enlarged and thorough examination of deep structures carried out.

(c) **Lacerated Wounds.**—Are produced by blunt instruments and crushing injuries, which cause tearing of the tissues. Hæmorrhage is slight and sepsis is liable to supervene in the damaged or dead tissues, resulting in suppuration or even gangrene. Healing is mainly by granulation and is slow, even if the wound remains aseptic.

Treatment.—Excision of all damaged or dead tissue if possible, removal of foreign bodies, and insertion of 5 to 15 grammes of sulphapyridine in powder form. Buried sutures of catgut or other material should be avoided. Free drainage is necessary. Prophylactic antitetanic and antigasgangrene serum are needed when gross contamination with dirt has occurred.

(d) **Gunshot Wounds.**—Partake of the character of punctured and lacerated wounds. They are almost invariably contaminated, and small skin wounds are associated with extensive damage to muscle and bone or internal organs.

Treatment.—Excision of the wound is called for at the earliest opportunity to avoid actual infection, which would inevitably occur in from four to eighteen hours, depending upon the nature and virulence of the organisms present, the amount of tissue damage, the loss of blood, and the degree of shock and fatigue.

Through-and-through wounds, especially those due to bullets, can often be left alone. In all cases seen after twenty-four hours the wound is infected and adequate drainage must be provided. If there is any suspicion of gangrenous infection of muscle, the wound should be widely opened up and the affected muscles completely excised.

Technique of Wound Excision.—1. The skin should be cleaned with soap and water, followed by ether or spirit.

2. Skin rarely requires extensive removal. In facial injuries it should never be sacrificed, and in other situations only the crushed edge needs excision.

3. The wound should be enlarged to secure adequate exposure of deeper structures.

4. Bruised tags of fascia should be excised.

5. Lacerated muscle along the wound track should be removed. Alteration in appearance and colour of any muscle, loss of contractibility on mechanical stimulation, or failure to bleed calls for wide excision.

6. Intermuscular spaces should be opened up and blood clot removed. Deep fascia should be freely divided in the long axis of the limb to allow for subsequent swelling of the muscles.

7. Detached fragments of bone need removal; but great care should be taken not to remove fragments which retain even a minimal blood supply.

8. Foreign bodies should, as a rule, be removed. Accurate localization by X-rays before operation is invaluable, especially in wounds containing fragments of metal.

9. The surgeon must bear in mind constantly the future function of the limb, taking care to preserve important nerves and vessels. In muscle excision it is preferable to remove longitudinal strips rather than to cut across some important muscle.

10. In no circumstances should the muscles, fascial or other deep layers be sutured with catgut. With regard to the skin, the question of primary suture is one calling for experience and judgment. If any doubt exists, the skin is best left unsutured.

Delayed primary suture within a few days of

excision may be carried out once it is known that infection has been avoided or overcome.

11. When there has been gross contamination, 5 to 15 grammes of one of the sulphonamide drugs should be sprinkled throughout the wound.

(e) **Poisoned Wounds.**—May be due to insect stings or snake bites.

(1) *Insect Stings.*—May be due to bees or wasps, and are exceedingly painful and dangerous if near the larynx owing to the resulting oedema. Weak bicarbonate of soda is the best application.

(2) *Snake Bites.*—May be very dangerous if the snake be a venomous one, and lead to extreme collapse and death. The blood loses its coagulability. The adder is the only common venomous snake in Great Britain, and one to two hours after its bite collapse may occur, but rarely death.

Treatment.—Consists in preventing absorption of the venom by tying a ligature above the part, excising the wound, rubbing in solid potassium permanganate, or injecting into the tissues calcium hypochlorite 1 per cent. solution. In addition, stimulants should be given and the appropriate antivenene injected, especially after bites by the cobra or rattlesnake.

Burns and Scalds.—Burns are produced by flame or heated solids, scalds by liquids or gases at a high temperature.

Degrees of Burns.—Dupuytren's classification: *First degree*, reddening of the skin. *Second degree*, blistering. *Third degree*, destruction of the epidermis, Malpighian layer, and papillæ of the dermis. The sensitive nerve terminals are exposed, consequently this is the most painful degree. The sweat and sebaceous glands and hair follicles are not destroyed, and from these epithelium spreads in healing, so that repair is rapid and the scar is not a contracted one. *Fourth degree*, the whole thickness of skin and part of the subcutaneous tissues are destroyed. *Fifth degree*, the muscles are injured. *Sixth degree*, the whole limb is charred.

The *local history* of a burn corresponds to the stages of an ulcer: (1) The stage of destruction; (2) the stage

of inflammation and sloughing, ending in a healthy granulating ulcer; (3) the stage of repair.

Clinical Course.—1. Period of **Shock**, which is primarily nervous in origin and secondarily toxic. The degree depends more upon the extent than upon the depth; also upon the situation, as burns of the body are more dangerous than burns of the limbs. Children stand burns very badly. Congestion of internal organs occurs at this stage.

2. Period of **Inflammation** lasts while the sloughs are being separated. Fever is produced by absorption of toxic products.

3. Period of **Healing** begins as soon as healthy granulations are formed.

Causes of Death.—(1) If the patient is taken out of the fire dead, asphyxia is the cause. (2) Shock and collapse. (3) Still later death may be due to toxæmia, or inflammation of internal organs, exhaustion from sepsis, septicæmia, pyæmia.

Treatment—General.—If carbon monoxide poisoning is present, artificial respiration and administration of oxygen; for shock, morphine, electric cradle, ample fluids, and intravenous citrated plasma, or concentrated serum (twice normal strength).

Local.—The indications are to minimize pain, prevent absorption of toxic tissue products, avoid sepsis and promote healing.

1. Anæsthesia is induced by nitrous oxide and oxygen or by 'pentothal,' and the part cleaned with soap and water followed by normal saline. Debris is removed with strict aseptic precautions. Care should be taken to avoid excessive heat loss by uncovering only a small area at a time. Sulphanilamide or sulphapyridine is then dusted gently over the part.

2. In most parts of the body some form of coagulant is usually employed. Silver nitrate 10 per cent., tannic acid 10 per cent., or 10 per cent. silver nitrate and 5 per cent. tannic acid alternately may be applied with gauze. Triple dye, consisting of equal parts of gentian violet (1:400), brilliant green (1:400), and neutral acriflavine (1:1,000) is

also widely employed. Care should be taken to see that the coagulum is firmly attached beyond the burnt area to avoid leakage of serum.

3. In the case of burns affecting the face, hands, wrists or feet, or involving the whole circumference of a limb, it is contended that excessive shrinkage of the coagulum may restrict circulation of the part. The matter is still *sub judice*, and for these cases an alternative method is to cover the burnt area first with a 'Tulle Gras' dressing and then six to eight layers of gauze soaked in saline. The gauze must be kept moistened during the day and may be changed daily.

4. Oily solutions containing an anæsthetic such as benzocaine provide an alternative method. Pain is controlled, and early active exercises can be carried out; œdema and stiffness are minimized.

5. In the 'envelope' method the burnt area is enclosed in a transparent water-tight silk fabric covering and irrigated regularly with electrolytic sodium hypochlorite solution (E.S.H.).

Frost-Bite is produced by severe cold, especially if a wind is blowing. It may occur in one of two ways: (a) From the direct effect of cold on the tissues. The circulation is completely stopped in the part, and gangrene occurs. (b) From the subsequent inflammation during thawing of a previously frozen part. The vessel walls are paralyzed, and the ensuing exudation is so great that the vessels are compressed.

Treatment.—Frozen parts should be thawed gradually to allow the vessel walls to recover tone. If gangrene occurs, the dead part should be kept aseptic till separation and healing have occurred.

Healing of Wounds.—Wounds are repaired by fibro-citrificial tissue. True regeneration may occur in bone, tendon, nerves, and striped muscle.

There are five methods of healing: By (1) first intention, (2) granulation, (3) blood clot, (4) under a scab, (5) union of granulations.

The particular form of healing depends on whether the edges of the wound are brought together or remain apart, and whether the wound is aseptic or septic. A wound always results in a microscopic

layer of injured tissue, and in this inflammation proceeds as far as the stage of exudation.

1. **Healing by First Intention.**—Occurs in an aseptic wound when the edges are in apposition. Exudation of plasma occurs, and its fibrinogen is converted into fibrin, which glues the edges of the wound together. Infiltration by leucocytes followed by fibroblasts next takes place. New capillaries form by budding out from adjacent ones and vascularize the new tissue. The fibroblasts give rise by intercellular exudation to fibrous tissue and at the same time epithelium grows over the narrow gap.

Conditions which prevent healing by first intention are: (1) Non-arrest of hæmorrhage, (2) sepsis, (3) lack of apposition of the edges, (4) lack of rest to the part.

2. **Healing by Granulation.**—Exudation of plasma and leucocytes occurs, followed by fibroblasts and budding from the capillaries, thus forming granulation tissue. The dead tissues or sloughs are separated and a red area of granulations is then exposed. As this is converted into fibrous tissue contraction occurs, and so the wound gradually lessens in size and the edges are brought closer together. Epithelium spreads in from the edge and thus the scar is completed.

3. **Healing by Blood Clot.**—Takes place only in an aseptic wound where there is a space left amongst the tissues, which becomes filled with blood clot. The clot is replaced by granulation tissue and the process is as above.

4. **Healing under a Scab.**—Only occurs in superficial wounds, the coagulated blood drying and forming a scab, which protects the subjacent part during healing.

5. **Healing by Union of Granulations.**—Occurs when two surfaces have been kept apart till granulations are formed and are then brought in contact. Adhesion occurs and union then takes place rapidly.

Complications of Scars.—1. *Excessive Contraction.*—Results in deformity and limitation of movement when near joints. Should be prevented by early active movements and skin-grafting. When present, treatment consists of excision of the scar, if possible,

otherwise division of contracted bands followed by skin-grafting. Recurrence may follow the secondary contraction of deeper structures.

2. *Keloid Growth*.—A mass of fibrous tissue develops, often raised and vascular, with ramifications into surrounding healthy tissue. The cause is unknown, but it may occur after any wound, even aseptic operation wounds healing by first intention. Excision is useless owing to recurrence in the new scar, but spontaneous disappearance may occur and X-ray or radium therapy is often beneficial.

3. *Adherent Scars*.—Are apt to cause pain on movement of the part when underlying muscles are involved.

4. *Painful Scars*.—Are due to involvement of nerve endings or to pressure on underlying cut ends of nerves in amputation stumps. The pain often radiates along the course of the affected nerve.

5. *Ulceration*.—Is due to interference with the blood supply by contraction of scar tissue.

6. *Malignant Disease*.—Occasionally commences in scars, taking the form of squamous-celled carcinoma.

Traumatic Fever.—May follow the receipt of an injury or an operation.

1. *Aseptic Traumatic Fever*.—Is due to the absorption of fibrin ferment, which is set free when blood is extravasated. The temperature rises to 100° or 101°, generally the second day after the injury or operation, and subsides after twenty-four hours.

2. *Septic Traumatic Fever*.—Is produced by the absorption of toxins from an infected wound. The temperature rises and remains high, and in addition there is headache, pain, and rapidity of pulse.

Traumatic Delirium.—(1) Toxic; (2) alcoholic.

1. *Toxic Delirium*.—Occurs in patients with septic injuries or wounds, and may be an active type, in which the patient is restless and talkative, especially at night; or a low muttering type, in which the patient is exhausted from long-continued suppuration or is of low vitality. He picks at the bedclothes, mutters, and has a dry, brown tongue.

2. *Alcoholic Delirium*.—Is often found when people

of intemperate habits receive injuries. The delirium comes on about the second or third day, but is preceded by tremulousness and sleeplessness. Violent shouting is a marked sign, due to the hallucinations, accompanied by struggling and attempts to get out of bed. The skin is moist and the bowels are confined. Great exhaustion follows, and may end in coma and death.

Treatment.—Many cases can be prevented if warning is taken by the tremulous state and sleeplessness. The bowels should be made to act by repeated doses of magnesium sulphate, and then a mixture of chloral, 20 grains, and potassium bromide, 20 grains, should be given every two hours till sleeping occurs. If delirium supervenes in spite of these measures, the patient must be restrained and sedatives given. He must be fed with fluids either by mouth or rectum and morphia in large doses ($\frac{1}{4}$ to $\frac{1}{2}$ grain) may be necessary.

SHOCK

Shock is a state of profound depression of the vital processes of the body resulting from injuries. It may be *primary* or *secondary*.

Primary Shock.—This comes on soon after injury and resembles fainting. The patient should be kept flat and warm, sedatives given for relief of pain, and stimulants administered.

Secondary or Wound Shock.—Develops insidiously some hours after injury. It closely resembles the effects of hæmorrhage in its clinical features, and is a condition of circulatory failure due to diminished blood volume, with a consequent fall in heart output and blood flow throughout the tissues.

Ætiology.—Contributory factors are (1) fatigue, exposure to cold, (3) pain and restlessness, hæmorrhage, (5) dehydration, (6) infection, and special injuries—*e.g.*, head, spinal, and chest wounds.

Pathology.—The essential feature is reduction of blood volume, possibly brought about by substances derived from tissue injury—*e.g.*, histamine. This

causes a general vaso-constriction in an effort to maintain the blood pressure at a normal level. Should the blood volume be reduced by more than 2 pints, the blood pressure cannot be maintained by vaso-constriction and begins to fall, in severe cases to lower than 50 mm. Hg. The tissue circulation is thereby reduced, and lack of oxygen causes irreparable damage. As a result, the capillary walls become more permeable and general leakage of plasma takes place. Once this has occurred, efforts to restore the blood volume by transfusion are thwarted, to some extent at least, by further leakage of plasma into the tissues.

Signs and Symptoms.—In the early stage pallor and a raised pulse rate are the only indications. Later the pulse rate increases, the pulse pressure decreases, and there is sweating. The blood pressure falls steadily, the temperature is subnormal, and the pulse becomes thready. The patient is often mentally alert and complains of intense thirst. Vomiting is common. The lips, ears and finger-tips are cyanosed, cold and clammy.

Diagnosis.—It is in the early stage that diagnosis is difficult. In any case of extensive injury with loss of blood and heat loss from exposure the onset of shock may be assumed. Pallor and coldness of the extremities with a pulse rate over 100 justify the diagnosis.

Treatment.—This should be instituted as early as possible, even though the systolic blood pressure is still over 100 mm. Hg. This pressure is being kept up by extreme vaso-constriction, but is liable to fall suddenly and quickly if an anæsthetic is given or if there is further loss of blood.

1. *Hæmorrhage and plasma loss should be controlled by firm bandaging of any wound or by a tourniquet, and by careful splinting to prevent movement of an injured part during transport.*

2. *Sedatives.*—Morphine in full doses, unless specially contra-indicated, is of great value in the relief of pain.

3. *Warmth.*—Hot bottles and blankets, bandaging

of the limbs, and an electric cradle or blanket are all useful.

4. *Fluids*.—Warm drinks containing sugar and salt should be given frequently except in abdominal cases. Half-normal saline solution with the addition of glucose 5 per cent. may be given by slow infusion per rectum.

5. *Restoration of Blood Volume*.—Transfusion of whole blood is of great value, particularly in cases associated with hæmorrhage. Human plasma and serum are strongly indicated when the reduction in blood volume is due to plasma loss only, as they dilute and decrease the viscosity of the concentrated circulating blood. The amount of blood plasma or serum must be large enough to restore the blood volume to normal. Mild cases require at least 2 pints, severe cases 4 pints. If blood, plasma or serum is not available, isotonic glucose or saline may be given slowly by the intravenous route, but in all forms of intravenous therapy care and judgment are needed to avoid pulmonary œdema.

6. *Oxygen*.—This may be administered by a B.L.B. mask or in a special tent or chamber. It is of especial value in chest injuries, when pulmonary œdema exists, or when carbon monoxide poisoning is present; in the latter case admixture with 5 to 7 per cent. CO₂ is indicated.

7. *Vasomotor Stimulants*.—Extracts of adrenal cortex (eucortone), adrenalin or pituitrin may be of value as a temporary expedient while measures are being instituted to restore the blood volume.

If an anæsthetic is needed, gas and oxygen is best, alternatively ether. Cyanosis must be avoided.

Prognosis.—The normal blood volume is about 9 pints. Experience has shown that any reduction down to 75 per cent. produces relatively little disturbance, the systolic blood pressure being over 95 mm. Hg and the pulse rate 90 to 110. Reduction of blood volume to between 65 to 75 per cent. is serious; the systolic blood pressure is 70 to 90 mm. Hg, and the pulse rate 120 to 140. When the volume falls to between 50 to 65 per cent. the condition is critical; the

systolic blood pressure is 60 mm., and the pulse rate 130 to 160.

Crush Syndrome.—Following prolonged crushing of the limbs such as occurs in air-raid casualties, the patient's condition when first released from fallen masonry, etc., may be reasonably good. After some hours severe shock may develop, although there may be no evidence of injury except slight abrasions and œdema of the crushed parts. Renal insufficiency is soon apparent—*e.g.*, oliguria and uræmia with blood casts in the urine. The blood potassium and phosphorus are raised, while the plasma chlorides fall, and it is suggested that this is an indication of muscle death. Early recognition of the crush syndrome and liberal administration of plasma or serum are important, but the prognosis is bad.

CHAPTER VI

HÆMORRHAGE

BLEEDING may be *arterial*, *venous* or *capillary* in origin. In arterial bleeding, blood of a bright red colour spurts from the cut vessel synchronously with the systole of the heart, and flows continuously during the diastole. In venous bleeding there is a steady flow of dark blood, except in the cervical veins, where it flows in jets at each expiration, with a steady flow between. Capillary bleeding is oozing from the surface of the wound. Bleeding into the tissues is called *extravasation*; if small and subcutaneous or submucous, *petechiæ* result. Bleeding from the nose is termed *epistaxis*, vomiting of blood *hæmatemesis*, coughing up of blood *hæmoptysis*, blood in the urine *hæmaturia*, altered blood in the fæces *melæna*.

General Symptoms.—(1) Pallor; (2) pulse rapid, small and weak; (3) respirations quick, sighing and gasping (air hunger); (4) temperature subnormal; (5) profuse sweating; (6) surface of body cold; (7) restlessness; (8) dimness of vision and noises in the ears.

Natural Arrest of Hæmorrhage.—(1) Temporary; (2) permanent.

Temporary Arrest.—Is brought about by: (1) Contraction of middle coat of artery; (2) retraction of inner and middle coats; (3) coagulation of blood; (4) fall of blood pressure. In the case of veins the walls fall together and coagulation occurs. Capillary bleeding stops quickly by coagulation.

Permanent Arrest.—Is due to organization of the blood clot and replacement by fibrous tissue.

Treatment—1. Arrest of Hæmorrhage.—(1) If instruments are not at hand, a *tourniquet* may be tied around a limb or digital pressure applied to the bleeding point or in the course of the main artery.

(2) *Pressure Forceps*—e.g., Spencer Wells—are applied to bleeding points.

(3) *Ligation* with catgut, silk, or thread.

(4) *Cautery*.—In vessels situated where ligatures cannot be applied, as in bones and tissues thickened by inflammation, cauterization or diathermy will stop bleeding.

(5) *Cold*.—In the form of ice, cold water, or exposure to the air, will stop oozing.

(6) *Hot Water* (130° F.).—Is useful for large bleeding cavities.

(7) *Direct Pressure*.—Either by plugging the wound tightly with sterile gauze or by firm bandaging over gauze dressings is often effectual.

(8) *Chemical Agents*.—(a) Styptics which act locally, causing coagulation—e.g., alum and tannic acid;

(b) adrenalin, which constricts the vessels.

(9) '*Hæmostatic Serum*' or '*Hæmoplastin*.'—Injected subcutaneously.

(10) *Morphine or Heroin*.—Alay restlessness and are valuable in internal hæmorrhage.

(11) *Calcium Chloride*.—Five c.c. of a 10 per cent. solution given intravenously is useful in cases associated with delayed clotting-time.

2. General Treatment—(1) *Rest*.—In recumbent posture with the head low.

(2) *Warmth*.—Hot bottles, blankets, bandaging the limbs over cotton-wool, and an electric cradle.

(3) *Blood Transfusion or Plasma Administration* (see below).

(4) *Saline Infusion*.—Normal saline is given intravenously, subcutaneously, or rectally.

(5) *General Measures*.—To stimulate the formation of blood. Good food, fresh air, sunshine, iron and liver extract are of value later.

Transfusion — *Indications*.—(1) Hæmorrhage, (2) shock, (3) anæmia from other causes, (4) sepsis, (5) hæmophilia.

Blood Grouping.—Before blood transfusion is carried out it is necessary to test the serum of the recipient against the donor's corpuscles. Broadly speaking, individuals fall into four groups:

	Serum.				Corpuscles.			
					1 (AB)	2 (A)	3 (B)	4 (O)
Group I	=	=	=	=
Group II (β)	x	=	x	=
Group III (α)	x	x	=	=
Group IV (α and β)	x	x	x	=

=, compatibility; x, incompatibility.

Individuals in Group I (AB) are termed *universal recipients*, those in Group IV (O) *universal donors*. This method of estimating compatibility is not infallible, as some cells behave irregularly, and for this reason cross-grouping is essential in each individual case.

Blood Transfusion.—The method almost universally employed is the citrate method. Coagulation is prevented by drawing off the blood into a solution of 100 c.c. of 3 per cent. sodium citrate in distilled water to which is added 20 c.c. of 15 per cent. glucose in distilled water. This amount suffices for 420 c.c. of blood (total=540 c.c.)

If it is intended to store the blood it should be

placed at once in a refrigerator and maintained at a temperature of 2° to 6° C. It should never be allowed to freeze. Stored blood should be used as soon as possible, but can be employed up to ten to fourteen days. Before use it must be warmed by standing the bottle in water at 40° C. (104° F.) for about fifteen minutes and rotating it gently at intervals.

Administration of Plasma.—Citratd plasma may be given for hæmorrhage and shock instead of blood. For storage it is not necessary to possess a refrigerator, but it should be kept in a cool dark place. If the bottle is found to contain clots it may still be employed provided some form of filter (gas mantle or glass bead) is used.

Dried Serum.—This is prepared by allowing blood to clot, after which it is bacteriologically filtered and dried from the frozen state. Dried serum is very stable and of great value under active service conditions when storage for long periods may be needed. It may be given in concentrated form, and is then particularly useful in burn shock. It may be given to recipients of any group. Before use it is diluted by adding sterile distilled water.

Dried Plasma.—Dried citrated plasma is prepared in the same way and is equally stable. It must be used without delay once it has been diluted with sterile distilled water.

VARIETIES OF HÆMORRHAGE.—*Primary hæmorrhage* occurs at the time of an injury. *Reactionary hæmorrhage* occurs as a result of failure of the temporary means of arrest, and usually in the first twenty-four hours. Common causes are the slipping of a ligature and a rise of the blood pressure. *Secondary hæmorrhage* is due to failure in the permanent means of arrest and the cause is sepsis.

Arterial Hæmorrhage.

1. **Primary Arterial Hæmorrhage.**—Is often severe and necessitates immediate measures for its control, such as *digital pressure*, either on the bleeding point or at a distance, when it is usually exerted against a

bony point (pressure point) or with a *tourniquet*, either improvised from a handkerchief or in the form of Samway's or an Esmarch's bandage.

As soon as possible the vessel must be exposed, secured at its bleeding point by pressure forceps, and ligated. In the case of large arteries, both ends must be secured.

2. **Reactionary Arterial Hæmorrhage.**—Results from failure to carry out the above measures, and necessitates reopening of the wound.

3. **Secondary Arterial Hæmorrhage.**—Results usually from septic infection, but may also occur in aseptic cases when there is advanced arterial disease, especially when unsuitable ligatures have been used or the knots tied too tightly. The wound shows signs of septic infection, and one day warning is given by a slight loss of blood from it. This is generally succeeded in a few hours or a day by a severe gush of blood, from which the patient may quickly die. Bleeding from arteries ligated in continuity is generally from the distal end, as the pressure is greater there when the collateral circulation is established. Secondary hæmorrhage commonly occurs from the eighth to the twelfth day.

Treatment.—If a large artery in a limb has been tied and the wound becomes septic, a tourniquet should be held in readiness so that it can be applied at a moment's notice. If bleeding occurs the wound should be opened, cleaned, and the bleeding point looked for and ligated. The wound should be left open and irrigated frequently. If the vessel cannot be ligated the cautery should be applied. If this does not stop the bleeding, the artery must be ligated on the proximal side by a separate incision.

Should these measures fail or bleeding recur, a more proximal ligature may be applied in the case of the arm, but is usually of no value in the case of the leg, and amputation is indicated.

The only possible treatment in the root of the neck, groin and abdomen is firm plugging if the bleeding cannot be controlled by ligation in the wound or cautery.

Venous and Capillary Hæmorrhage.

Small veins collapse and bleeding soon ceases. Large veins and those whose walls are rigid, as in varix, continue to bleed.

Treatment.—As for arterial hæmorrhage, with the exception that if a vein be punctured or torn slightly, a ligature can be applied to the opening without occluding the vein. Bleeding from a large vein can easily be stopped by plugging the wound if, as in the case of a cranial sinus, it cannot be tied.

Air Embolism.—Hæmorrhage from veins in the neck or axilla is liable to be associated with the entrance of air into the circulation. During inspiration the thorax has an aspiratory action, so that if veins are held open air is drawn in. Veins are held open in the neck where they pierce the deep fascia, in inflammatory tissue where the walls are rigid, or if a piece of the wall is removed while traction is being made on the vein. The air and blood become churned up into froth in the right auricle and ventricle and the heart cannot eject it, the patient dying very rapidly.

Signs.—The air enters with a sucking noise. If much enters, the patient becomes faint; there is great dyspnœa, rapidity and weakness of pulse, convulsions, and death rapidly supervenes.

Treatment.—To prevent entry of air, veins should be secured before division. If entry occurs, a finger should be placed on the point at once to stop further entry, or the wound filled with saline. The vessels should then be secured. The head should be lowered, the body and limbs raised, stimulants given, and artificial respiration carried on.

Capillary Hæmorrhage.—Copious when from inflamed parts, and can be arrested by pressure, cold or heat, styptics or cautery.

Hæmophilia.

Hæmophilia is a congenital and hereditary disease in which severe bleeding occurs from slight wounds and the patients are liable to spontaneous hæmorrhages.

The bleeding may be from the surface, subcutaneous, or into joints. The disease is transmitted through females, who are not affected, to the males of the succeeding generation. It appears that the blood platelets are abnormal in quality, and as a result thrombokinase is deficient.

Treatment.—Russell's viper venom (1=10,000) applied locally is very effective. If the bleeding point is not accessible, transfusion of blood or plasma is indicated.

CHAPTER VII

TUMOURS—RADIOTHERAPY—CYSTS

TUMOURS

TUMOURS are new formations which tend to grow or persist, which fulfil no function and appear without apparent cause. Inflammatory swellings and hypertrophies are thus excluded.

Etiology.—1. Chronic and long-continued irritation, with or without infection, is a common precursor of tumour formation, which may be delayed for many years after the irritation has ceased.

2. Misplaced and undeveloped cells, the result of embryological maldevelopment, are very prone to give rise to new growths.

3. There is at present no evidence of any specific factor which can be held directly responsible for the capacity for unlimited growth which tumour cells display.

4. Recent research has shown that certain hydrocarbons—*e.g.*, benzpyrine—of relatively simple chemical constitution will produce epithelioma if applied to the skin, and sarcoma if injected into the connective tissues of susceptible animals. It is possible that certain allied carcinogenic substances may be elaborated in the living human tissues (*e.g.*, derivatives of cholic acid, and of œstrin, etc.).

Tumours are divided into two main groups clinically, innocent and malignant; but it must be re-

membered that this is an arbitrary division and every gradation occurs between the two.

Innocent Tumours exhibit the following characters:

(1) They are encapsuled, or, when diffuse, do not infiltrate. (2) They do not invade the lymph glands. (3) They do not recur after complete removal. (4) They do not disseminate. (5) They only imperil life by their mechanical action—*e.g.*, a lipoma obstructing the bowel. (6) They may be multiple.

Malignant Tumours exhibit the following characters:

(1) They infiltrate surrounding structures. (2) They invade adjacent lymph glands. (3) They tend to recur after apparently complete removal. (4) They become disseminated in distant organs. (5) They inevitably destroy life unless removed. (6) They are usually single.

Classification of Tumours:

I. Connective Tissue Tumours—derived from mesoblast.

1. Angioma (bloodvessels).
2. Chondroma (hyaline cartilage).
3. Fibroma (fibrous tissue).
4. Lipoma (fat).
5. Lymphangioma (lymph vessels).
6. Myoma (muscle).
7. Myxoma (mucoid tissue).
8. Glomangioma.
9. Xanthoma.
10. Neurofibroma (nerve sheath).
11. Osteoclastoma.
12. Osteoma (bone).
13. Odontoma (teeth or teeth germs).
14. Chordoma (notochord).
15. Endothelioma (endothelial tissue).
16. Sarcoma (connective tissue).
17. Multiple myeloma (bone marrow).

II. Epithelial Tumours—derived from epiblast or hypoblast.

1. Papilloma (surface epithelium).
2. Adenoma (gland tissue).
3. Carcinoma (epithelial tissue).

III. **Teratomata**—derived from mesoblast and epiblast or hypoblast.

IV. **Nervous Tissue Tumours.**

1. Glioma (neuroglia).
2. Neuroblastoma.
3. Ganglioneuroma.
4. Pheochromocytoma.

V. **Melanoma** (pigment tissue).

VI. **Hypernephroma.**

VII. **Chorionepithelioma.**

Connective Tissue Tumours.

1. **Angioma** is a tumour composed of an abnormal formation of bloodvessels: (1) Simple nævus; (2) cavernous nævus; (3) plexiform angioma.

Simple Nævus consists of a mass of dilated capillaries held together by connective tissue, is usually congenital, and may increase in size during the first few months of life. It may be cutaneous or subcutaneous, and is either bright red or dusky. Ulceration and hæmorrhage may occur. Treatment may be by excision, carbon dioxide snow, electrolysis, radium applicator, or near-distance low-voltage X-ray therapy.

Cavernous Nævus consists of dilated spaces intervening between the arteries and veins in place of capillaries, thus resembling erectile tissue. It may be cutaneous or subcutaneous, and diffuse or circumscribed. It can be emptied by pressure. Excision or diathermy needling is usually employed.

Plexiform Angioma (aneurysm by anastomosis or cirroid aneurysm) consists of a number of abnormal bloodvessels, which may reach a large size, may cause absorption of underlying bone, or ulcerate through the skin, causing death by hæmorrhage. The common situation is the scalp. Ligation of the main arteries should precede any attempt at excision.

2. **Chondroma** is a tumour composed of hyaline cartilage, the cells of which are arranged irregularly;

it may become calcified, ossified, or undergo mucoid change. Two main varieties occur:

(1) *In Large Bones*.—Firm, lobulated, encapsuled and of slow growth. Arise near epiphyseal cartilage in children and young adults, often the subjects of diaphyseal aclasia.

(2) *In Small Bones*.—Often multiple, expanding the bones, especially in the hand.

Treatment consists of local removal, but occasionally amputation is necessary. Types (1) and (2) may occur in the same patient.

3. **Fibroma** is a tumour composed of fibrous tissue and may be hard or soft. In most cases other tissue elements are present—*e.g.*, fibro-lipoma.

(1) *Hard Fibroma* is commonly seen on the gum of the lower jaw (fibrous epulis) and in the ovary.

(2) *Soft Fibroma* may occur on the surface of the body as a pedunculated growth or pendulous fold (molluscum fibrosum).

Local excision may be called for.

4. **Lipoma** is a tumour composed of fat. It may be localized or diffuse. When localized it forms a soft and semi-fluctuating swelling, which is irregularly lobulated and encapsuled, and may or may not be adherent to the skin. They may be multiple and occur in many situations. The commonest site is in the subcutaneous tissue, but they may be in subserous tissues, beneath synovial or mucous membranes, between or in muscles, and in connexion with periosteum and the meninges of the brain and spinal cord.

Diffuse Lipoma is an overgrowth of fat in the subcutaneous tissue which occurs in middle-aged people, often beer-drinkers. It is not encapsuled, is always symmetrical, and generally beneath the chin or at the back of the neck.

Fat may be mixed with other tissues in a tumour, giving rise to fibro-lipoma, myxo-lipoma, nævo-lipoma; sarcomatous change may also occur.

Treatment is by removal, which, however, in the diffuse form is seldom practicable.

5. **Lymphangioma** is a tumour composed of dilated lymphatic vessels or lymphatic spaces.

(1) *Lymphatic naevus* occurs on the skin or tongue; (2) *cavernous lymphangioma*; (3) *lymphatic cyst* (cystic hygroma), generally occurring in the neck, axilla, or groin, and always congenital.

Excision is the treatment where possible, or, alternatively, injection of chemicals such as sodium morrhuate.

6. **Myoma** (*leiomyoma*), a tumour of unstripped muscle and of common occurrence, frequently found in the uterus, and less often in the prostate. Muscle tissue is usually mixed with fibrous tissue (*fibromyoma*) or gland tissue (*adenomyoma*). *Rhabdomyoma* (stripped muscle) is very rare.

7. **Myxoma**, a rare tumour composed of connective tissue cells, separated by a large amount of mucoid intercellular substance, so that the cells appear spider-like. They are found in the skin and in relation to tendons, periosteum or joints. Myxomatous growth is frequent in connexion with sarcoma.

8. **Glomangioma**.—A tumour of a cutaneous glomus—i.e., a specialized arteriovenous anastomosis surrounded by large pale cells (glomus cells), between which is an abundant network of nerves. It occurs most commonly in the extremities, especially in the nail-bed. It is a slow-growing encapsuled tumour, blue or reddish in colour, and may be symptomless or give rise to severe attacks of burning pain. Removal effects a complete cure.

9. **Xanthoma**.—This term is applied to a group of yellowish-brown growths of the skin, probably due to a metabolic disturbance which gives rise to the characteristic lipid-containing 'foam-cells.' The eyelid is the commonest situation, but the tumours may be scattered over the skin surface or rarely occur in other situations such as tendon sheaths. They are often found in association with disturbances of cholesterol metabolism—e.g., diabetes.

10. **Neurofibroma**, a tumour growing from the sheath of a nerve, occurs in three main forms:

(1) *Localized Neurofibroma* may grow from a subcutaneous twig (painful subcutaneous nodule) or from the main trunk of a nerve (trunk neuroma). The

former causes intense neuralgic pain, especially when touched or exposed to cold. Muroid degeneration and sarcomatous change may occur, evidence of the latter being complete paralysis and anæsthesia.

Treatment.—Removal, if possible without dividing the nerve.

(2) *Generalized Neurofibromatosis (von Recklinghausen's Disease).*—Multiple tumours, spindle-shaped or spherical, occur in connexion with any part of the nervous system, including the sympathetic. They may be tender. Sarcomatous change is not uncommon.

(3) *Plexiform Neurofibroma.*—A diffuse, soft overgrowth (myxofibromatous), confined to a particular nerve or plexus and producing a network of tortuous, soft, mobile, subcutaneous strands. It occurs congenitally or in young people, and usually affects the trigeminal or superficial cervical nerves. Treatment consists in dissecting out the affected portion.

Traumatic or amputation neuroma is a bulbous swelling sometimes found in the cut ends of nerves, and causing severe pain if adherent to bone or scar. It consists of scar tissue, containing coiled-up axis cylinders (or nerve fibrils), and is not a true tumour.

11. *Osteoclastoma (Giant-Cell Tumour).*—This is probably derived from osteoclasts and is composed of soft very vascular tissue traversed by fibrous trabeculæ. Microscopically the tumour consists of a spindle-celled stroma with scattered giant cells containing numerous nuclei situated towards the centre of the cells.

12. *Osteoma.*—There are two main varieties of innocent bone tumour:

(1) *Cancellous Osteoma.*—Pedunculated or sessile, with a cap of hyaline cartilage and an overlying bursa when exposed to pressure. Derived from pieces of epiphyseal cartilage and found near the ends of long bones, especially the radius and femur. Usually cease growing when the main bone does, and the cartilaginous cap then becomes ossified. Hard and painless unless pressing on nerves, and may be multiple. Removal is indicated if causing symptoms.

(2) *Ivory Osteoma*.—Composed of very dense bone and occurs most frequently in the orbit, frontal sinus, external auditory meatus, mastoid process and angle of the jaw. May give rise to severe pressure symptoms. Removal by an electric saw may be needed.

Exostoses are abnormal deposits of bone, possibly of inflammatory origin: (1) Ossification of tendons at their attachments; (2) subungual exostosis—from the last phalanx of the big toe, growing under the nail and causing great pain.

Treatment consists in exposing the growth, and gouging it away.

13. *Odontoma*.—Arises from some abnormal condition of the tooth germs or growing teeth. Varieties: (1) *Epithelial*, from the enamel organ; (2) *follicular*; (3) *fibrous*; (4) *cementome*; (5) *compound follicular*; (6) *radicular*; (7) *composite*. The only two which are common are the epithelial and follicular odontomes, which will be considered later (p. 300).

14. *Chordoma*.—A rare tumour arising from remnants of the notochord, usually from basi-sphenoid or basi-occipital bones or caudal end of the vertebral column.

15. *Endothelioma*.—Arising from lining endothelium of (a) bloodvessels, (b) lymph vessels, (c) serous cavities. The cells become spherical, cubical, or even columnar in shape, and tend to arrange themselves around small spaces and vessels (perithelioma). One variety in the meninges undergoes hyaline degeneration and calcification (psammoma). Clinically these tumours are less malignant than sarcoma and carcinoma, tending rather to recur locally than to affect glands or internal organs. They occur principally in the meninges of brain and spinal cord, pleura and peritoneum.

16. *Sarcoma*.—A malignant connective-tissue tumour which may be congenital or appear at any age, being commoner in young people.

It arises from mesoblast, may be at first defined or encapsuled, but always in its later stages infiltrates surrounding tissue. It may develop from a previously

benign tumour. The blood supply is abundant, even to producing a pulsating tumour. The vessels are mere clefts between the cells, so that interstitial hæmorrhage is frequent, and dissemination by the veins is rendered easy. Secondary growths usually occur first in the lungs, unless the primary growth is in the portal area, when the liver is involved. Occasionally lymphatic glands are invaded, especially in lympho-sarcoma, sarcoma of tonsil, testis, and thyroid. Degenerative changes, such as myxomatous, fatty and hæmorrhagic, may occur.

A sarcoma when cut appears homogeneous, and varies, according to its vascularity, from the greyish-white of a fibro-sarcoma to the reddish hue of a round-celled sarcoma.

Histologically a sarcoma consists of cells embedded in varying amounts of intercellular tissue. Two main groups may be distinguished:

I. The cells are embryonic and so little differentiated that the tissue of origin cannot be defined.

II. Differentiation is advanced enough for the tissue to be recognized.

I. These growths are extremely malignant and soon lead to a fatal termination.

Varieties.—(a) *Round-Celled Sarcoma*.—Consists of a mass of round nucleated cells, with very little intercellular substance. There are three types: (1) Small round-celled; (2) large round-celled; (3) lympho-sarcoma in which the cells are small, and which differs from other sarcomata in that it arises from the cells of lymphoid tissue.

(b) *Spindle-Celled Sarcoma*.—The cells vary in size, but they are all oat-shaped or fusiform. Frequently patches of immature hyaline cartilage are present.

(c) *Mixed-Celled Sarcoma*.—The cells are of various shapes, some round and others fusiform.

II. These growths are less malignant than the preceding group. *Fibro-sarcoma, myxo-sarcoma, chondro-sarcoma, osteo-sarcoma, lipo-sarcoma* and *myo-sarcoma* are recognized.

Treatment of Sarcoma.—1. *Complete excision* is seldom possible, but is the best method when it can be carried out.

2. *Irradiation* by X-rays or radium. Many of these tumours are very sensitive to this form of treatment.

3. *Coley's Fluid.*—A sterilized culture of *Streptococcus pyogenes* and *Micrococcus prodigiosus* in bouillon is injected into the tumour or subcutaneously, and is said sometimes to effect a cure. The dose is cautiously increased from $\frac{1}{2}$ minim up to a maximum of 8 minims twice or thrice weekly.

17. **Multiple Myeloma.**—A rare disease in which multiple tumours develop in the skeleton, most commonly in the sternum, ribs, vertebrae, skull and femora. Microscopically the growth consists of diffusely arranged round cells, probably derived from the blood-forming tissues of the marrow, and little or no intercellular substance. (See also p. 143.)

Epithelial Tumours.

1. **Papilloma.**—Is formed from surface epithelium which may be: (1) Squamous (skin, mouth, lip, larynx, and penis); (2) transitional (urinary tract); (3) cubical or spheroidal (breast); (4) columnar (ducts of glands, ovary).

It has a central core of connective tissue containing vessels, and the epithelium does not grow down into the subcutaneous or submucous tissue, thus differing from carcinoma. The papillæ may be long and branched (villous papilloma), as in the urinary and alimentary tracts, or may undergo keratinization (common wart). In breast and ovary, and occasionally elsewhere, papillomata may develop as intracystic growths; there is a distinct liability to malignancy.

If irritated, papillomata may undergo malignant change, in which case the base becomes infiltrated.

2. **Adenoma.**—Arises from a secretory gland and in structure closely resembles it. The epithelium may be spheroidal, cubical or columnar in shape, and

may produce secretion. The alveoli which are formed may become distended with fluid (cystic adenoma). The tumours may be single or multiple, and are usually encapsuled. They are only dangerous when situated where they may compress important structures (*e.g.*, trachea) or cause obstruction (*e.g.*, intestine).

3. Carcinoma (Cancer).—A malignant growth arising from epithelium. The tumour cells multiply indefinitely, and invade both basement membrane and underlying connective tissue. They spread along the lymph spaces and vessels to adjacent lymph glands, sometimes invade the blood stream and form secondary growths in other parts of the body (metastases). The cells differ individually in shape and size, some showing irregular mitoses (tripolar or multipolar). In general, the more undifferentiated they are, the more malignant the carcinoma.

The connective tissue around the growth is infiltrated by small round cells and plasma cells, which in some cases develop into fibrous tissue (scirrhous carcinoma).

Varieties, classified according to the epithelium from which the growth is derived: (1) Squamous; (2) basal; (3) columnar; (4) spheroidal.

1. Squamous-Celled Carcinoma (Epithelioma).—Arises from skin or any surface covered with squamous epithelium—*i.e.*, lips, mouth, pharynx, vocal cords, œsophagus, vulva, vagina, cervix uteri, penis, anal canal, urethra, and bladder (transitional). It usually arises in the middle-aged or elderly, but may also occur in the young. It often results from long-continued irritation, and may arise in old scars or ulcers, and in certain occupations (chimney-sweeps). There are three distinct forms: (a) A warty growth with an indurated base; (b) a small circular ulcer with raised rampart-like edges; (c) an indurated fissure. The growth spreads to the deeper structures, the surface ulcerates and becomes foul from contamination with putrefactive organisms. The nearest lymph glands are invaded sooner or later, and a fatal termination occurs unless treatment is early and

thorough. Secondary deposits, except in the glands, are rarer than in glandular carcinoma. The glands sometimes break down, the skin over them is invaded and ulceration follows. Secondary hæmorrhage from ulceration into large bloodvessels may cause death.

Microscopically, columns of cells derived from the prickle-cell layer are seen extending into the underlying tissue and interlacing with one another. In some of the columns, concentrically arranged masses of flattened cells occur called cell nests, and imperfect keratinization may be found.

Treatment—(1) *Primary Growth*.—May be treated in one of several ways: (i.) Free excision by scalpel or diathermy knife. (ii.) Radium by: (a) Needles inserted around and into the growth; (b) surface application in moulded applicators made of Columbia paste; (c) large amounts directed from a distant source (teletherapy). (iii.) Low-voltage near-distance X-ray therapy.

(2) *Lymphatic Glands*.—Are, if possible, excised in one mass with the primary growth. Radium or X-ray therapy may be employed either alternatively to or in conjunction with excision.

2. **Basal-Cell Carcinoma (Rodent Ulcer)**.—Commences in the cells of sebaceous glands or the basal layer of the rete Malpighii. It generally occurs in patients over forty, and is of very slow growth. It begins as a smooth, flattened nodule or plaque in the skin about the nose, eyelids, orbital angles, or cheeks. In time ulceration occurs. The ulcer has a smooth depressed base covered with ill-formed granulations and bounded by a slightly raised, indurated edge. There is little discharge if sepsis is prevented, and little or no pain. The lymph glands are never invaded, and dissemination does not occur. The ulcer spreads and destroys surrounding structures; even bone is not spared, so that the brain may ultimately be exposed.

Microscopically, columns of small rounded epithelial cells are seen, but never prickle cells, and seldom signs of keratinization or cell nests. The peripheral

cells are elongated and arranged side by side in palisade formation.

Treatment.—Low-voltage near-distance X-ray therapy is the ideal. If not available, a radium applicator and free local excision are alternatives.

3. **Columnar-Celled Carcinoma (Adeno-carcinoma).**—Arises from the secreting epithelium of glands and from their ducts. Imperfect alveoli are formed, separated by a varying amount of connective tissue (stroma). These tumours are most frequently met with in the alimentary canal (stomach, colon, and rectum), where infiltration of the submucous and muscular layers occurs, ulceration is common, neighbouring lymph glands are invaded, and dissemination to viscera follows. Colloid or mucoid degeneration may occur and is often indicative of a high degree of malignancy.

This type of carcinoma is also found in the breast (duct carcinoma), uterus and pancreas, but may occur in any gland.

4. **Spheroidal-Celled Carcinoma.**—Is derived from glandular epithelium, the tumour cells being found in solid groups, with little or no attempt at the formation of acini. The stroma varies in amount, being either a conspicuous feature (*scirrhus* and *atrophic scirrhus*) or scanty (*encephaloid*). Scirrhus occurs most frequently in the breast, usually in older people, and on section is like an unripe pear. Encephaloid (medullary) carcinoma is soft and pale, but is often pigmented by interstitial hæmorrhages. It is found in the breast, testicle and kidney, growing very rapidly, with early invasion of lymph glands and visceral metastases.

Treatment of Columnar and Spheroidal-Celled Carcinoma.—Wide excision of the affected part, together with the lymph glands draining it and the intervening tissue in one piece, by scalpel or diathermy, still remains the method of choice. This may be supplemented by irradiation (X-rays or radium) before and/or after operation.

These two types of carcinoma are not easily destroyed by irradiation (radio-resistant), particu-

larly when in the lymph glands, but radium and X-rays are indicated in inoperable cases to prolong life.

Teratomata.

These tumours are derived from mesoblast, epiblast, and hypoblast in any combination, and it is thought that they may arise from inclusion, during development, of the products of another individual (included twin). Any tissue may be found consisting of either typical or atypical cells; hair, teeth, intestinal villi, bone and sebaceous material are common.

These growths occur most frequently in the ovary (ovarian dermoid), and also in the testicle and sacrococcygeal region. They may be either solid or cystic. Some, especially if situated in the ovary, remain unchanged for years or enlarge by distension of the cystic spaces. Others, especially teratomata of the testis, are usually very malignant.

Mixed Tumours.—The origin of these is disputed, but while many favour an origin similar to that of teratomata—i.e., from more than one germ layer—others ascribe them to cellular metaplasia. They occur in: (1) Salivary glands, especially the parotid. In this region they contain epithelium, which may be basal or squamous celled, mucoid areas, as well as areas which resemble cartilage and glandular tissue. Growth may at first be very slow, but eventually often becomes rapid. (2) Kidney. (3) Lips and palate.

Nerve Tissue Tumours.

1. *Glioma*.—A tumour derived from the cells of the supporting tissue of the brain, the neuroglia. Most of these tumours fall into three groups: (a) *Astrocytoma*, composed chiefly of adult neuroglia cells or astrocytes. (b) *Spongioblastoma*. The primitive spindle-shaped cell or spongioblast is the predominant cell. (c) *Medullo-blastoma*. This rare tumour consists of small, round or carrot-shaped cells derived from the medullary epithelium. (See also p. 288.)

2. **Neuroblastoma.**—A tumour arising from immature nerve cells of the sympathetic nervous system and generally occurring in the adrenal medulla of young children. It consists of small round cells and characteristically staining fibres, and is usually malignant. (See p. 563)

3. **Ganglioneuroma.**—A highly differentiated nerve tumour occurring in connexion with the sympathetic trunks, most commonly in relation to the suprarenal gland of children.

4. **Pheochromocytoma.**—A tumour of the adrenal medulla which may be benign or malignant. It consists of spheroidal or columnar cells and contains adrenalin, which is released intermittently and gives rise to characteristic clinical effects. (See p. 563.)

Melanoma.

A tumour derived from cells containing pigment or its precursors. Some consider it to be derived from mesoblastic pigment cells, others from epithelial cells. The most recent work suggests that it arises from specialized cells associated with the sensory nerve endings of the skin. *Three types* are distinguished:

1. **Benign Melanoma or Nævus.**—This may be pigmented or non-pigmented. The pigmented type is extremely common. It may take the form of a flat plaque or a warty growth, and is often covered with coarse hairs. These moles may be situated anywhere, but are commonest on the face, neck or back.

2. **Malignant Melanoma developing from a Benign Growth.**—Malignant change may occur spontaneously or follow irritation, and may be gradual or sudden. Clinically it is diagnosed by rapid increase in size and vascularity, ulceration, enlargement of lymph glands, the appearance of metastases or local recurrence after removal.

3. **Malignant Melanoma arising as a Primary Growth.**—This is probably the most malignant of all tumours. It may spread by direct infiltration, by

lymphatic invasion or *via* the blood stream, and the metastases may be so numerous as to cause a *generalized melanosis*. Though the primary growth may be only slightly pigmented, the secondary deposits are frequently of an inky black hue and *vice versa*. The microscopic appearances are very varied, and the cells may be epithelial, spindle-shaped or endothelial in type.

Ocular melanoma arises from the pigmented structures of the eye, and is usually very malignant, but metastases may not be apparent for many years after removal of the primary growth.

Hypernephroma.

• This tumour is now generally regarded as a renal adenocarcinoma. The microscopical appearances are variable, but the tumour cells are usually large and clear or slightly granular, due to the presence of globules of lipoid. They are arranged in sheets, cords, tubules or papillæ, and situated in a scanty stroma with numerous bloodvessels. (See also p. 560.)

Chorionepithelioma.

One of the most malignant of tumours, derived from the cells covering the chorionic villi. It occurs after an abortion or pregnancy, and in about one-third of cases is preceded by a hydatidiform mole. Frequently it is associated with bilateral lutein cysts of the ovary. Usually arising at the placental site, it extends into the cavity and muscular wall of the uterus, forming a soft hæmorrhagic mass which soon disseminates via the blood stream. Microscopically it consists of actively growing Langhans' cells and masses and strands of multinucleated syncytium.

Two varieties can be distinguished: (a) *Choriocarcinoma*, as described above. Tumours with a similar structure also occur in the testis. (b) *Syncytioma*, which is composed of syncytium, blood clot and necrotic tissue, and characterized by a marked tendency to spontaneous retrogression.

Treatment.—Total hysterectomy of the Wertheim type is indicated in early cases, followed by radium or X-ray treatment to the pelvis. Chorionepithelioma is very radio-sensitive, and radiotherapy is therefore of value for late cases and for metastatic growths. In some cases metastases retrogress after removal of the primary growth.

RADIOTHERAPY

During the past few years great advances have been made in the treatment of tumours, in particular of those displaying malignant characteristics, by the scientific application of physical principles in the use of radium and X-rays. Empiricism has largely given way to standardized technique (Mayneord's) based on an estimation of the amount of energy absorbed in all parts of the tissue irradiated (volume distribution). There has consequently been a marked improvement in the results achieved by radiotherapy varying from nearly 100 per cent. cures of the primary growth in superficial sites to 25 to 30 per cent. in organs such as the larynx, tongue, pharynx, etc. Further progress may confidently be anticipated in the treatment of deep-seated lesions as technical advances are made.

Estimation of the energy absorption in different parts of irradiated tissue is obtained by employing the Roentgen (r) as a unit, and it is thereby possible to compare the results of radium and X-ray therapy. The physical basis of the Roentgen is the electrical conductivity produced in air by X-rays or γ -rays, measured by the electric charge set free by the rays per c.c. of air under standard conditions.

Dosage.—The response of malignant tumours to radiotherapy is very variable and at present unpredictable in many cases in spite of expert histological examination. It may be broadly stated that doses varying from 3,500 to 6,000 r frequently result in the death of malignant tumour cells, but it must be realized that results vary according to the time taken in administering this dose.

Radium Therapy (Curietherapy).—Radium is a metallic element employed for clinical purposes in the form of salts (bromide, chloride or sulphate). It is an important representative of the radio-active elements which emit α -particles (doubly positively charged helium atoms) with very little penetrating power; β -particles (electrons) with more penetrating power and destructive to all tissues, causing necrosis (these may be screened off by thin layers of metal—0.5 mm. platinum, 1 mm. lead); γ -rays, which are electro-magnetic waves resembling ultra-violet and X-rays, but of much shorter wave length and greater penetrating power; γ -rays appear to have a selective action in destroying malignant cells.

Technique—1. *Teleradiation (Beam Therapy).*—Large quantities of radium varying from 1 to 10 grammes are enclosed in a special container (radium bomb) having lead or tungsten alloy walls which prevent the escape of γ -rays except in the direction desired. The rays escape through an aperture which is screened to prevent emission of β -particles. The beam of γ -rays is directed by a special calliper on to the field decided upon, and multiple fields are used in most cases. This method is of special application in carcinoma of the mouth, pharynx, larynx, and in superficially situated growths—*e.g.*, maxilla, penis and anus.

2. *Interstitial*—(a) *Hollow needles* made of platinum-iridium alloy, which acts as a screen to β -particles, but allows the passage of γ -rays, and containing radium salts (usually sulphate), are embedded in the affected part for several days. They are mainly employed for small accessible tumours or for completing the destruction of part of a growth which has resisted teleradiation.

(b) *Radon Seeds.*—Radon is a radio-active gas resulting from the disintegration of radium and emitting γ -rays. It is collected in capillary tubes and enclosed in gold or platinum (radon seeds). These seeds are buried in the tissues, and within fourteen days have lost 90 per cent. of their activity. Radon seeds are of use in deep-seated lesions—*e.g.*, stomach

or lung—when interstitial irradiation is considered desirable.

3 *Surface Application*.—Radium needles are embedded in dental wax or Columbia paste moulded to the part. Applicators are of great value in carcinoma of the cervix and in skin cancer.

X-Ray Therapy.—X-rays are electro-magnetic waves of shorter wave length than those of infra-red, visible or ultra-violet light, but not as short as γ -rays of radium. The higher the voltage used, the shorter the wave length and the greater the penetrating power (hard rays). Screening with aluminium, copper or tin is employed to cut off the rays of longer wave length and less penetration (soft rays).

Technique—1. *Low-Voltage Near-Distance Therapy*.—Apparatus of original design has been made available in the past few years by which X-rays generated at low voltages (30 to 60 k.V.) can be employed. The target of the X-ray tube is placed close to the skin (contact therapy). The destructive effect is limited to the area to be treated, by special metal applicators. Limited penetration is ensured both by the short focal skin distance and the nature of the radiation.

2. *Medium and High-Voltage Therapy*.—X-rays of medium wave length generated at voltages of 100 to 150 k.V. are employed for many purposes. Their main field of application is in the superficial tissues—e.g., breast, axillary, cervical and inguinal glands, larynx and pharynx. Owing to the marked falling off in the depth dose, these rays are of less value for deep-seated lesions. The latter are usually treated by more penetrating radiations generated at voltages of the order of 200 k.V.

3. *Super-voltage Therapy*.—X-rays of shorter wave length and greater penetration are generated at 300 to 1,000 k.V., and are now regularly employed in the treatment of carcinoma of the œsophagus, lung, pelvis, etc. Encouraging results are being obtained by accurate dosage using Mayneord's volume distribution curves and his ingenious apparatus for accurate localization of the X-ray beam.

Conclusion.—Radiotherapy in one form or another is the treatment of election in many cases of malignant disease, particularly those involving superficial tissues. Its sphere of usefulness is limited by the fact that each patient can only tolerate a certain quantity of radiation over a given period. Excess dosage may produce extensive necrosis of soft tissues or bone (radio-necrosis), or may result in serious or fatal changes in the bone marrow, as evinced by a rapid decrease in the circulating leucocytes.

The treatment of individual lesions will be considered in the appropriate sections.

CYSTS

• A cyst is a cavity containing fluid or semifluid material, and having a distinct lining membrane.

Classification :

1. *Dermoid* : (a) *sequestration* ; (b) *implantation*.
2. *Retention*.
3. *Embryonic*.
4. *Serous cavity* : *synovial*.
5. *Parasitic*.
6. *Pseudo-cysts* : (a) *blood* ; (b) *degeneration*.

Sequestration Dermoids.—Arise in detached portions of skin where coalescence has taken place between cutaneous surfaces during embryonic life. Thus, the middle line of the body, the situation of the facial and branchial clefts, are common sites. They form rounded, elastic, movable swellings. The skin moves freely over them, but they may have pedicles going deeply even to the dura mater through the skull. They are generally filled with sebaceous material, but rarely contain hair. *Pilonidal cyst* is a hair-containing dermoid found in the sacro-coccygeal region. Sequestration dermoids should be completely dissected out, or they recur.

Implantation Dermoids.—Are caused by accidental implantation, through punctures or wounds, of portions of skin into the subcutaneous tissue. Small

cysts form lined by skin. They are commonest on the fingers, hands and the cornea.

Retention Cysts.—Are caused by some obstruction in the duct of a gland, preventing escape of secretion. They occur in the breast (galactocœle, cystic mastitis), mouth (ranula), pancreas, kidney.

Sebaceous Cysts result from obstruction to the ducts of sebaceous glands. Though occurring anywhere, these cysts are commonest on the scalp (wens) and face, and are often multiple. Each cyst forms a soft doughy swelling, in the middle of which the blocked duct can usually be seen as a black speck. Infection and suppuration may occur. Treatment is by complete removal.

Embryonic Cysts.—Occur in connexion with embryonic ducts and canals, which normally disappear before birth: (1) Thyro-glossal; (2) post-anal; (3) branchial; (4) urachal; (5) vitello-intestinal; (6) paroöphoronic; (7) parovarian; (8) cystic disease of testis; (9) Wolffian duct; (10) Gärtner's duct. (11) Müllerian duct; (12) processus vaginalis (encysted hydrocele of cord).

Synovial Cysts.—Arise in three ways: (1) Hernial protrusions of the synovial membrane of joints (Baker's cyst); (2) bursæ in the neighbourhood of joints; (3) hernial protrusions of the synovial sheath of tendons.

Hydatid Cysts.—Are due to *Tænia echinococcus*, which inhabits the intestine of dogs, especially in Iceland and Australia. The parasite is $\frac{1}{2}$ inch long, and consists of four segments. The embryos are passed in the fæces, and contaminate water or food. Each is contained in a capsule, which, after it enters the human stomach, is dissolved by the gastric juice. The free embryo then bores its way into a bloodvessel and is carried most often to the liver, but sometimes to other organs. The cystic stage follows. An adventitious capsule is formed around it by conversion of the structures in the immediate neighbourhood into fibro-cicatrical tissue. The true hydatid mother cyst consists of two layers—ectocyst and endocyst. From the endocyst tænia heads, or

scolices, each provided with four suckers and a ring of hooklets, are formed, and often daughter cysts as well. Occasionally the cyst is sterile. The fluid contained in the cyst is colourless, of low specific gravity, with only a trace of albumen. Hooklets are always present. Special tests, such as the intradermal of Casoni, will confirm the diagnosis in doubtful cases.

Hydatid. cysts may (1) rupture; (2) die spontaneously, shrinking into a pultaceous mass; or (3) suppurate.

Treatment.—The adventitious cyst should be freely opened. The mother cyst and its contents, which have no attachment to the adventitious cyst, can then be lifted out.

Blood Cysts.—Are due to trauma producing extravasation of blood, which becomes walled off.

Degeneration Cysts.—Are found in many kinds of tumour, some receiving special names—*e.g.*, cystic hygroma and serous cyst (cavernous lymphangioma), cystic adenoma of breast or thyroid gland.

CHAPTER VIII

INJURIES AND DISEASES OF BLOODVESSELS

ARTERIES

Contusion does little harm as a rule, unless the artery is atheromatous or calcareous, when thrombosis may occur and lead to gangrene.

Rupture may be caused by blows, strains, attempts to reduce old-standing dislocations or bend stiff joints if the artery is adherent to the tissues which are mobilized. If the inner and middle coats only are ruptured, thrombosis occurs at the site and occlusion of the artery follows or a weak area remains, at which an aneurysm may develop.

Diffuse Traumatic Aneurysm.—The result of complete or partial subcutaneous rupture with extensive extravasation of blood.

Symptoms.—The patient feels something give way.

and localizes pain to the site injured and along the course of the artery.

A large pulsating swelling is rapidly formed, and the skin becomes distended and blue. Later œdema and redness appear. Distally, pulsation of the vessels is absent, the limb becomes cold, and sensation is impaired. The colour of the limb is usually white or blue if the venous return is interfered with by the swelling. If much blood is extravasated, the patient is pale and restless, with a rapid pulse.

Terminations.—(1) Rupture, if the swelling increases so much that the skin gives way or sloughs: if into the peritoneum or pleura, death may occur rapidly. (2) Suppuration, either from direct infection from without or auto-infection, and the condition then simulates a large abscess. (3) Gangrene of a limb may be produced by pressure on the main vessels. (4) Limitation of the swelling may occur, both the clot and the hole in the artery being replaced by fibro-cicatricial tissue.

Treatment.—The ruptured artery should be exposed and both ends tied. If suppuration has occurred, proximal ligation of the main artery may be needed. Gangrene or secondary hæmorrhage may call for amputation.

Penetrating Wounds.—If completely divided in an open wound, the treatment is that for arterial bleeding. If the wound is valvular, conditions similar to subcutaneous rupture are produced. If an artery is incompletely divided, free hæmorrhage occurs from the gaping wound: therefore the division of the vessel must be completed. If a small artery is divided so near to the main vessel that a ligature cannot be applied safely, the main trunk must be ligated both above and below the branch. Small wounds of large arteries have been successfully sutured with fine silk. Punctured wounds may be closed at first by blood-clot, then by a cicatrix, which may, however, subsequently yield forming an aneurysm.

Arterio-Venous Wounds result from penetrating injuries which involve an artery and vein lying in contact. Two conditions may follow:

1. Aneurysmal Varix.—In this the artery opens directly into the vein. The vein and its branches, being unable to resist the arterial pressure, dilate and pulsate. A loud systolic bruit is heard.

Treatment.—An elastic bandage generally relieves this condition; but if pain or inconvenience persists, the artery should be tied above and below the opening into the vein. In the orbit, electrolysis must be tried.

2. Varicose Aneurysm.—An aneurysmal sac exists between the openings in the artery and vein. The sac is formed of laminated clot and fibro-cicatricial tissue. The signs are those of aneurysmal varix, but the sac may be palpable and the bruit is softer.

Treatment.—The artery must be tied above and below the sac. If possible, the sac and the parts of the artery and vein at the site of abnormal communication should be excised.

Acute Arteritis.—Involves all the coats of an artery, and is due to the presence of sepsis, either from without, as in a septic wound, or from within, as in pyæmia when a septic embolus lodges in the vessel. Secondary hæmorrhage may result in the first case, aneurysm in the second.

Chronic Arteritis.—May take one of several forms:

1. Atheroma.—A condition found in the arteries of those who take alcohol in excess; or as a sequel to gout, nephritis or syphilis. The large arteries are chiefly affected.

Atheroma may lead to: (a) thrombosis; (b) detachment of a plate, forming an embolus; or (c) dissecting aneurysm, due to the blood-stream forcing its way between the muscular coats of the vessel.

2. Endarteritis Obliterans.—In this condition the intima becomes very markedly thickened, and ultimately either obliterates the lumen or leads to thrombosis. It occurs in various diseases, especially in syphilis affecting the smaller arteries—*e.g.*, around gummata. It is found also in diabetics and alcoholics. In them the larger arteries, such as the posterior tibial, are affected, resulting in defective nutrition of the limb or even gangrene.

Primary Calcareous Degeneration.—Mostly seen in

the smaller arteries of the extremities of old people, and is due to the deposit of lime salts in the middle coat. Ultimately this coat is converted into a rigid inelastic calcareous tube, so that only a minimal quantity of blood can pass. The effect of this is to produce anæmia, impaired nutrition, and coldness of the affected limb. Thrombosis may result from very slight injury, and senile gangrene is a common termination.

Aneurysm.—This is a cavity containing blood, and communicating with the lumen of an artery. There are two kinds: true and false. A *true* aneurysm is a dilatation of part of the arterial wall, and is preceded by degeneration. A *false* aneurysm follows a wound of the arterial wall, which takes no part in the formation of the sac; it has already been described under the heading 'Diffuse Traumatic Aneurysm' (see p. 81).

Causes of Aneurysm.—Evidence of disease of the vessel wall, usually atheroma, is always present, and dilatation occurs only after the middle coat has been weakened. Contusions or strains may rupture the media, and so produce weakness, which favours subsequent dilatation. Increase in the blood pressure by sudden and violent exertion tends to the production of aneurysm.

Structure.—At first the sac is formed by one or more of the arterial coats, but as it increases in size it is solely composed of the condensed cellular tissue around. Soon the endothelial lining disappears, and fibrin is deposited on the walls in a laminated manner. Often there are alternate layers of red and white clot.

Varieties—1. *Sacculated Aneurysm.*—The dilatation arises from one side of the artery only, and the sac communicates with the vessel by a comparatively narrow opening.

2. *Fusiform Aneurysm.*—A general dilatation of the whole circumference of an artery. Its progress is slower than that of the sacculated variety, and there is little or no laminated clot at first. It usually ends in the formation of a sacculatation at one part.

3. *Dissecting Aneurysm* occurs in atheroma, the

blood forcing its way between the coats of the vessel. It cannot be recognized during life.

Signs and Symptoms—1. *Intrinsic Signs*.—An expansile tumour, pulsating synchronously with the heart, associated with a bruit, lies in the course of a vessel. If the artery is compressed on the cardiac side pulsation ceases, and the tumour becomes softer and can be diminished in size by pressure. On removal of the compression the tumour regains its size in two or three beats. Pressure on the distal side of the sac makes it more tense.

2. *Extrinsic Signs* are due to pressure by the sac and to interference with the circulation. (1) The pulse on the distal side is diminished and delayed; (2) pressure on the veins may cause congestion, œdema, and even gangrene; (3) pressure on nerves produces pain, anæsthesia, or paralysis; (4) bones are eroded and spontaneous fracture may occur; (5) cartilage is less affected than bone; (6) tubes, such as the trachea and œsophagus, are compressed and ulcerated, and the aneurysm may burst into them; (7) the heart is hypertrophied because of the increased work thrown upon it; (8) emboli may be detached, and gangrene result.

Differential Diagnosis.—Aneurysm may be simulated by: (1) Tumour or chronic abscess receiving transmitted pulsation from an artery nearby. In this case the impulse is not expansile, ceases if the mass is moved, and the tumour is not diminished in size by compression of the artery above. The pulse below is not delayed as in aneurysm. (2) Pulsating sarcoma: this may be easily distinguished if it fails to coincide with the line of an artery. Its consistence is not uniform, there is infiltration of the surrounding tissues, and pressure on the artery above diminishes its size but slightly. (3) Rheumatism or neuralgia: careful examination in all cases will avoid this mistake.

Results.—1. *Spontaneous cure* rarely occurs. It may be due to the deposition of laminae of fibrin until the sac is obliterated; this only occurs in smaller arteries, and if the opening into the sac is small.

More commonly natural cure is due to pressure by the sac on the main artery above or below, producing coagulation of blood in the vessel. An embolus may block the vessel below and produce the same condition. Very rarely suppuration in the sac may cause spontaneous cure.

2. *Rupture*.—The usual result if untreated. It may either occur on to a free surface or subcutaneously, in the latter producing a diffuse aneurysm. Rupture of an internal aneurysm usually causes intense pain and death ensues rapidly. Rupture of an external aneurysm may be sudden or gradual. If gradual, the tumour slowly increases, and its outline is less defined; pulsation is diminished, and signs of increased pressure on nerves and veins may usher in gangrenous changes. If sudden, there is severe pain in the part, swelling rapidly increases and becomes tense, brawny, and non-pulsating. Gangrene follows from pressure on the collateral circulation. Suppuration and external rupture may supervene.

3. *Suppuration* may arise from infection during operation, or by auto-infection when an aneurysm has become diffuse. The tumour becomes red, hot, swollen, painful and œdematous, and if left alone it points, pus and blood are discharged, the patient either dying at once or later from repeated hæmorrhages.

Treatment—Medical.—An attempt is made to produce conditions which will favour the occurrence of coagulation in the sac. In Tufnell's method the patient is kept recumbent on a restricted diet (10 ounces of solids and 8 ounces of liquid in the twenty-four hours). If possible this is kept up for two or three months. Potassium iodide, 15 to 60 grains t.d.s., and calcium chloride, 5 to 10 grains b.d., are given.

Surgical.—1. *Excision of the Sac*.—The best operation where possible. A tourniquet is applied, the sac exposed and dissected out. The artery is tied above and below the opening into the sac; if this is large, it should be incised and emptied. If the vein is adherent to the sac, it also should be removed. This operation carries less danger of gangrene than liga-

tion at a distance, as only one collateral circulation has to be established instead of two.

2. *Obliteration of the Sac (Matas's Obliterative Endo-aneurysmorrhaphy).*—With a tourniquet applied, the sac is freely opened and emptied of blood and clot. The openings of all vessels entering the sac are sewn up by silk sutures, redundant portions of the sac removed, and the remainder folded over and sewn together.

3. *Ligation of the Artery.*—Four types are classical:

(1) *Anel's Operation.*—The artery is ligated close to the sac on the proximal side and only one set of collaterals need develop for success.

(2) *Hunter's Operation.*—Proximal ligation at a distance from the sac, one branch intervening between sac and ligation. Two sets of collaterals must open up for success—viz.: (a) That from above to below the ligation; (b) from above to below the sac.

(3) *Brasdor's Operation.*—Ligation of the main artery on the distal side.

(4) *Wardrop's Operation.*—Ligation of one or more of the main branches of the artery on the distal side.

4. *Amputation* may be required: (a) When gangrene has set in; (b) when joints have been opened or bones so eroded as to destroy the utility of a limb; or (c) in some cases of subclavian aneurysm, to diminish the amount of blood flowing through the sac.

5. *Other Methods.*—(a) Compression may be digital or mechanical, continuous or intermittent; (b) galvanopuncture; (c) introduction of foreign bodies into the sac; (d) acupuncture. Being rarely effective, these are seldom used today.

Special Aneurysms.

Aneurysm of Common Carotid is usually near the bifurcation and on the right side, and commoner in women than in men. The ordinary signs distinguish it, but if at the root of the neck it may be difficult to distinguish carotid aneurysm from that of the aorta, innominate, or subclavian. Percussion and auscultation of the upper part of the chest may

reveal that the tumour is also intrathoracic; aneurysm of the carotid is purely cervical. Pressure on the left recurrent laryngeal nerve is due to aortic aneurysm; on the right, to aneurysm of the innominate and its branches. Tracheal tug is due to aortic aneurysm. Compression of the internal jugular or subclavian vein points to carotid or subclavian aneurysm respectively. Differences in the pulses may also help to locate the site of dilatation. If the temporal pulse only is altered, then the aneurysm is in the common carotid, whereas if both right radial and temporal are changed, the aneurysm is in the innominate. A weak pulse in neighbouring arteries may result from pressure of the aneurysmal sac upon the parent trunks.

Glands, tumours, and abscesses lying over the carotid artery, and receiving pulsation from it, are distinguishable by careful examination.

A pulsating goitre is easily detected by the fact that it moves on swallowing. A tortuous condition of the terminal portion of the common carotid sometimes leads to error, but it is usually bilateral and therefore easily differentiated.

Treatment.—Proximal ligation. If the aneurysm is at the base of the neck, distal ligation may alone be possible.

Intra-Orbital Aneurysm appears as a pulsating swelling in the orbit, causing exophthalmos. Vision gradually becomes impaired and the cornea inflamed, when the eyelids can no longer cover and protect the eyeball. A penetrating wound or a blow is the usual cause, or the artery may be felt to give way with a definite snap. Various conditions besides true aneurysm may cause pulsating exophthalmos, such as aneurysm by anastomosis (congenital), aneurysmal varix between the internal carotid and cavernous sinus, and pulsating tumours of the orbit.

Treatment.—Electrolysis should be first tried, and if it fails, the common carotid should be tied.

Intracranial Aneurysms are by no means rare. Those situated below the clinoid processes (sub-clinoid) are amenable to ligature of the internal

carotid on the affected side, as determined by arteriography. The supraclinoïd group are more likely to rupture and less curable by carotid ligation.

Subclavian Aneurysm is more frequent in men and on the right side. Usually it is in the third part. A pulsating swelling forms in the subclavian triangle and spreads downwards towards the axilla, compressing the brachial plexus and veins, and causing pain and œdema. In the early stages the condition may be simulated by a normal artery pushed forward by a cervical rib.

Treatment.—The ideal treatment, where the aneurysm is limited, is extirpation. Ligation on the proximal side is usually necessary, and as there is rarely sufficient room to tie the first part of the subclavian, the innominate must be chosen. It is then always necessary to tie the common carotid as well, for if this is not done, the reflux stream of blood is such that the quantity flowing through the sac is not diminished. Distal ligation is only of service if the arm be amputated at the same time. Where operation is inadvisable, galvano-puncture by Macewen's needles should be tried.

Aneurysm of Axillary Artery is generally traumatic and due to falls, fractures, dislocation of the shoulder, or attempts at reducing the latter.

Treatment.—If the aneurysm is of the third part, ligation of the third part of the subclavian; if of the first part, ligation of the first or second part of the subclavian. Aneurysms at the distal end of the artery are usually traumatic, and can be extirpated.

Abdominal Aneurysm may affect either the aorta or its branches. An expansile pulsating swelling is formed, which does not alter its characters on change of position. Pressure-effects comprise pain, congestion, and œdema. Tumours lying in front of the aorta may transmit pulsation, which disappears if the patient is examined in the knee-elbow position.

Treatment.—Cases have been successfully treated by Macewen's needles or by galvano-puncture.

Popliteal Aneurysm gives rise to a pulsating tumour in the popliteal space, which causes difficulty in using

the knee and pain along the course of the nerves. It either extends forwards and erodes the knee-joint, or backwards and tends to become diffuse. If diffusion occurs, gangrene is very likely to follow. It has to be diagnosed from enlarged popliteal glands, abscess, pulsating sarcoma, and enlarged bursæ.

Treatment.—Compression or ligation. Extirpation is difficult, but the next best thing is to tie the popliteal artery at its upper part. If this is not possible, ligation of the femoral at the apex of Scarpa's triangle or in Hunter's canal is usually successful. Matas's obliterative operation may also be employed.

Arterial Embolism results from (a) an impacted sterile thrombus; (b) infected clot from a septic focus; (c) fibrinous vegetations from cardiac valves or atheromatous plates; (d) malignant cells; (e) fat globules; (f) air bubbles; (g) parasites.

Results.—The artery becomes completely blocked by the addition of fibrin to the embolus. According to the size of the artery and the nature of the collateral circulation the outcome may be a mere transient anæmia, infarction or gangrene of a limb or part of the alimentary canal.

In the limbs the embolus usually lodges at the bifurcation of the main vessels, with sudden acute pain localized to the site of the impaction followed by loss of sensation and function in the distal part of the limb.

Treatment.—Immediate longitudinal incision of the artery, removal of the clot followed by careful suture with the finest vaselized silk may lead to restoration of the circulation and avoidance of gangrene.

VEINS

Phlebitis is inflammation of a vein, venous thrombosis coagulation of blood within its lumen. It is highly probable that one never occurs without the other, although in some cases this is difficult to prove.

Causes.—Those of inflammation, acute and chronic (pp. 6-7). In practice, the following are the common ones:

1. *Trauma*.—Any injury, including operations, may produce division, rupture, puncture, compression or contusion of veins, and be followed by phlebitis.

2. *Bacterial Infection*.—May occur *via* the bloodstream from a distant focus, which may be obscure, or by spread from some adjacent focus which infiltrates the wall of the vein. The resulting phlebitis may be localized (simple phlebitis), or spreading (infective or septic phlebitis), depending upon the virulence of the causative organism.

3. *Chemical*.—Intravenous injection of certain chemicals may produce phlebitis, particularly if there is disease of the wall of the vein (*vide* varicose veins).

4. *Toxic Absorption*.—In many infective conditions—*e.g.*, typhoid fever, puerperal sepsis—phlebitis may occur.

5. *Gout* may produce so-called idiopathic phlebitis.

6. *Long-Continued Pressure* by a tumour or aneurysm is sometimes responsible.

Pathological Changes.—The wall of the vein is thickened, there is proliferation of the endothelial lining, with formation of a red thrombus if the blood coagulates *en masse*. If the process is slow, the clot is formed mainly of fibrin and is then pale. If red corpuscles are entangled in it, it is called a mixed thrombus. The clot extends to the next branch.

The later history depends on whether or not the thrombus is aseptic. In aseptic cases the thrombus is (a) replaced by fibro-cicatrical tissue and the venous channel is obliterated at that site; (b) new venous channels are formed through the clot so that the lumen of the vein is restored, or (c) thrombi lying behind the valves of varicose veins may be infiltrated with calcareous material, forming phleboliths. In septic cases the clot may be disintegrated, portions carried off into the circulation and pyæmia set up.

Results.—Distal to the affected area there may be congestion of the terminal veins. If a main trunk is affected, œdema of the part occurs, and, unless the collateral circulation is adequate, gangrene may follow. The development of the collateral circulation is often very obvious when situated superficially, as, for

example, when the femoral vein is blocked and the internal saphenous vein carries on the circulation, through its superficial epigastric branch either to the contralateral saphenous vein or up to the axillary vein of the same side.

Symptoms—1. *Simple Phlebitis*.—There is pain and tenderness in the part, and the formation of a hard cord in the course of the vein, with redness or dusky discoloration of the skin over it. The patient is otherwise well and there is little or no pyrexia. Œdema is slight or absent unless the deep veins are involved, when there is deep-seated pain, fever and œdema of a more or less solid character.

2. *Septic Phlebitis* is accompanied by high temperature, diffuse redness of the skin over the vein, and œdema in the vicinity. Suppuration occurs later, and if emboli are carried into the blood-stream, pyæmia follows.

Treatment—1. *Simple Phlebitis*.—(a) Rest and elevation of the part until all tenderness has gone, possibly for several weeks. (b) Intravenous injection of 5 to 10 ounces of 0.5 per cent. sodium citrate in normal saline. (c) Local applications to relieve pain—e.g., 'antiphlogistine,' fomentations, glycerine and belladonna. (d) Massage, but not until several weeks have elapsed after all signs of inflammation have subsided. (e) Elastic supports or crêpe bandages. When there is evidence of spread of thrombosis to the larger vessels, and particularly if it is multiple, continuous drip intravenous infusion of saline containing 'heparin' is advisable.

2. *Septic Phlebitis*.—The vein must be exposed on the proximal side of the thrombus, ligated in two places and divided. The suppurating area must then be thoroughly opened up, and the thrombus removed or the vein excised.

Embolism is the lodgment of some substance or body (embolus) in a bloodvessel causing obstruction. The embolus may be of many kinds—blood-clot, fat, bacteria, malignant growth, air. If the vessel is an important one, the results may be serious, as in the classical pulmonary embolus. In this condition a

large piece of thrombus blocks the main pulmonary artery at its bifurcation and death often occurs in a few minutes. As will be described (see 385), recovery has occasionally followed the heroic operation of pulmonary embolectomy.

Varicose Veins.

A varicose vein or varix is one which has become dilated, elongated, and frequently in addition, tortuous. Those commonly affected are the superficial veins of the leg, but sometimes the deep veins are also involved. Other common sites are the hæmorrhoidal plexus (piles) and the pampiniform plexus (varicocœle).

Causes.—1. Inherited weakness of the veins, possibly associated with abnormality of the valves.

2. Conditions favouring congestion: (a) Prolonged standing; (b) tight garters; (c) the pressure of a pelvic tumour or gravid uterus; (d) occlusion of deep veins from thrombosis; (e) aneurysmal varix (rare).

Pathological Changes.—The first change apparent is loss of elastic and muscular tissue in the tunica media and their replacement by white fibrous tissue. This is followed by thickening of the adventitia. Later the vessel wall becomes thinned, the valves atrophy, and cystic dilatations of the vein occur. The veins also elongate and become tortuous.

Dilatation induces incompetence of the valves and allows backflow of blood towards the periphery.

The varicose condition may affect the main subcutaneous veins, with or without involvement of the deep-seated veins, or be mainly confined to small, superficial venules.

Symptoms.—In some cases the condition appears to cause no discomfort, but treatment is sought owing to the unsightliness. Most patients complain of a heavy, tired feeling of the leg, particularly after standing or walking; a few of pain in the affected segment of vein, frequently worse at night when in bed.

Complications.—1. *Phlebitis.*—Usually affects superficial veins, is sometimes the result of trauma and

then almost painless. Rest need not be enforced for so long as in other types of phlebitis.

2. *Eczema*.—Particularly liable to occur in cases involving minute cutaneous venules.

3. *Ulcer*.—See p. 186.

4. *Rupture*.—May give rise to alarming hæmorrhage, which can easily be controlled by direct pressure and elevation of the foot.

5. *Œdema* of foot and leg is common when the deeper veins are affected, particularly after deep-seated thrombosis (white-leg).

Treatment.—1. *Intravenous Injection* aims at obtaining obliteration of affected veins by the use of chemical solutions, which cause phlebitis and thrombosis, followed by organization. The solutions most frequently employed are: (a) Sodium morrhuate, 5 per cent. or 10 per cent.; (b) sodium salicylate, 30 per cent.; (c) quinine hydrochloride (0.11 gramme in 1 c.c.) and urethane. The first has the advantage of being less liable to cause necrosis of the tissues around the vein in the event of leakage.

Technique.—With strict aseptic precautions, injections are made with a glass-barrelled syringe fitted with a fine needle. The patient may be recumbent or sitting up, and injections are made towards the periphery, after withdrawing blood to ensure that the needle is in the lumen of the vein. Injections are made at two or three sites at each sitting, repeated at intervals of one to two weeks.

Contra-Indications.—(1) Recent phlebitis; (2) pregnancy; (3) general disease—e.g., myocarditis; (4) deep-seated thrombosis.

It should be noted that in a minority of cases there is a tendency for the veins to recanalize following intravenous injections, even after a period of years. In such cases a second series of injections may succeed, especially if combined with ligation of the main venous trunk.

2. *Operation.*—Ligation of the main saphenous trunk in the upper part of the thigh may be of value in extensive varices involving this vein. This should be combined with an intravenous injection of sufficient

volume to produce widespread thrombosis in the whole varicose area.

3. *Palliative Treatment*.—Various forms of support, of which the two most commonly employed are elastic stockings made to measure, and crêpe bandages.

Nævus.—Is the term used to describe certain types of angioma developing in the skin, subcutaneous or submucous tissues, and either congenital or appearing soon after birth. They may disappear after a time, persist, or grow rapidly. There are two varieties: capillary and cavernous.

1. **Capillary Nævus** occurs as a bright red or purple area in the skin or mucous membrane. It consists of a mass of capillaries held together by connective tissue. It may be minute or cover very large areas (port-wine stain), even in extreme cases involving half the body surface.

Treatment.—Carbon dioxide snow or electrolysis is often successful. If not, surface application of radium may effect a cure. Local excision with or without some form of skin-grafting is the most reliable method.

2. **Cavernous Nævus** involves the subcutaneous as well as the cutaneous tissues. It is generally bluish in colour, and consists of spaces lined by endothelium, with arteries opening directly into them without the intervention of capillaries. It appears as a soft, non-pulsating swelling, diminishing on pressure, but refilling when this is relaxed.

Treatment.—Excision is the best treatment when practicable. Alternatives are diathermy, radium and electrolysis when the condition is too diffuse for excision.

Nævo-Lipoma.—A tumour, usually congenital, composed of fatty and nœvoid tissue. It has the lobulated character of a lipoma, with dilated veins or capillaries on its surface, and can be made to shrink by pressure. Treatment is by excision.

CHAPTER IX

INJURIES AND DISEASES OF THE LYMPHATIC SYSTEM

LYMPHATIC VESSELS

Wounds are only of importance when it is the thoracic duct which is injured; there is then a free escape of chylous fluid. If the opening be tied, the wound closed, and firm pressure applied, no ill-effect is likely.

Acute Lymphangitis is always secondary to some focus of infection, such as a septic abrasion or cut. In most cases the inflammation is due to the direct action of organisms in the lymphatic vessels, but occasionally to toxins only. The process, though often limited by the nearest lymphatic glands, may spread further.

Pathology.—The walls of the lymphatics are acutely inflamed, and the surrounding tissues are also affected, so that when suppuration occurs the pus is not confined to the lumen of the lymphatic vessels.

Symptoms.—Shivering and rise of temperature, with headache and loss of appetite, accompanied by the presence of red lines in the skin, running from the primary focus to the nearest lymphatic glands. The inflamed lymphatics are painful and tender. Small abscesses may occur at intervals along their course, or suppuration in the glands, and septicæmia or pyæmia may supervene.

Treatment.—Frequent hot baths and the usual measures for acute inflammation. Chemotherapy is often of great value, many cases being due to *Str. hæmolyticus*.

Chronic Lymphangitis is sometimes seen following primary syphilis, in the dorsal lymphatics of the penis which are hard and cord-like but subside with anti-syphilitic measures. It also occurs in tuberculosis of superficial parts, forming nodules which caseate and may require excision.

Lymphangioma is nearly always of congenital origin, and consists of a mass of lymphatic vessels and connective tissue. There are two varieties: capillary and cavernous.

1. *Capillary Lymphangioma* is usually congenital, but often grows rapidly after birth. Smooth-topped or warty yellowish-brown patches in the skin mark this form. The treatment is excision or cauterization.

2. *Cavernous Lymphangioma* is made up of lymph spaces, into which the lymphatic vessels open, and may occur in the skin, forming small vesicles like those of herpes, but without any inflammation. Incision and cauterization is the treatment. In the deeper structures, especially in the neck, a large multilocular swelling occurs called *cystic hygroma*. Removal is difficult, as they are often very extensive and may be intimately connected with the great vessels and nerves of the neck, or more rarely of the groin; but the attempt should be made if they are rapidly increasing. Alternatively aspiration and injection of sodium morrhuate 5 or 10 per cent. should be tried.

Lymphangiectasis.—A varicose condition, due to obliteration of the main trunks by inflammation or the pressure of cicatrices. The most extreme degrees are due to the presence of the *Filaria sanguinis hominis*. Obstruction to the thoracic duct may cause rupture, and chylous fluid is then found in the abdominal or pleural cavities. Chylous hydrocele is probably due to lymphatic obstruction.

Elephantiasis is due to chronic lymphatic obstruction, and manifests itself as: (a) Solid œdema; (b) dilated vesicles in the skin which may rupture, discharging lymph (lymphorrhœa); or (c) great thickening of skin and subcutaneous tissues. There are two varieties:

1. *Filarial* (*E. arabum*) is due to obstruction of lymphatics by embryos of *Filaria sanguinis hominis* and affects chiefly the external genitals and the legs.

2. *Non-Filarial* (pseudo-elephantiasis) following (a) malignant disease or tuberculosis in lymph glands; (b) extensive removal of lymph glands; or (c) repeated lymphangitis from chronic ulcer or eczema.

Treatment.—1. In filarial cases, if the adult parasite can be localized, it should be removed.

2. Elastic pressure, elevation of the parts, and massage.

3. Plastic operations so designed as to provide a flap or series of flaps of healthy skin to provide an alternative lymphatic route for the obstructed limb are favoured by many, since lymphangioplasty has been proved a failure.

4. Kondoleon's operation. Excision of a broad wedge-shaped slice of tissue, including deep fascia, along the whole length of the limb.

5. Excision of affected parts is of great value in scrotal elephantiasis.

6. Amputation may be called for in the case of a limb.

LYMPH GLANDS OR LYMPH NODES

Acute Lymphadenitis.—Is due to bacteria or their toxins which have reached the lymph-gland from some primary focus in the area drained by it.

Pathology.—Swelling of the gland occurs, frequently accompanied by adhesion to surrounding structures, owing to spread of inflammation through the capsule (periadenitis). This may be followed by cellulitis and suppuration.

Signs and Symptoms.—The general symptoms of inflammation are present, and the glands are palpably enlarged and tender. Unless suppuration occurs, the pain subsides and the swelling slowly disappears. Should suppuration occur, the glands become fixed to surrounding structures and to the skin, redness appears over them, and later fluctuation is evident. In loose tissues, as in the axilla or neck, diffuse cellulitis may be set up.

Treatment must be directed to the primary focus. For the glands, rest, by splinting, etc., and frequent applications of hot compresses or of 'antiphlogistine.' If an abscess forms, it must be drained.

Chronic Lymphadenitis is either simple, syphilitic, or tuberculous.

1. **Chronic Simple Lymphadenitis** results from septic absorption due to chronic ulcers, eczema, diseased tonsils, bad teeth, and pediculosis. The glands are enlarged and tender, but not adherent to one another, and with little tendency to suppuration. Treatment consists in removing any source of infection and placing the part at rest. If the glands still remain enlarged or increase, they are probably tuberculous.

2. **Syphilitic Lymphadenitis** may be: (1) In the nearest glands to a primary sore. Suppuration never occurs unless pyogenic organisms are present. (2) In the secondary stage many glands are enlarged, especially the post-cervical chain. They are small, hard, painless, and do not suppurate. (3) In the tertiary stage gummata may affect lymph glands, as may suppuration, through organisms absorbed from a broken-down gumma. The treatment is that for syphilis.

3. **Tuberculous Lymphadenitis.**—Most commonly found in people under twenty years, but may occur at any age. Predisposing factors are hereditary predisposition and a condition of lowered vitality from lack of fresh air, or improper food. Simple chronic adenitis generally precedes tuberculous infection. The bacilli gain access by some breach of the surface or through diseased tonsils or adenoids, and are conveyed to the lymph glands. The glands most commonly affected are the cervical, bronchial, and mesenteric, but any in the body may be involved.

Pathology.—The glands are at first enlarged and firm, and tubercles can only be seen microscopically. Caseation usually follows, and later calcification, but more frequently suppuration ensues. By suppuration is meant liquefaction of the tuberculous tissue, but now and then pyogenic infection supervenes. At first the pus is confined within the capsule of the gland, but afterwards several affected glands may unite and a large cavity forms. In the later stages, periadenitis fixes the mass to the deeper structures and to the skin. Still later the abscess bursts on the surface, leaving one or more openings, with thin undermined edges, which discharge pus for a

long time. After healing, a puckered keloidal scar may be left.

Treatment—1. *General Measures*.—Fresh air, nourishing food, and sunshine or general ultra-violet light.

2. *Local Treatment*.—Local ultra-violet light, rest, aspiration of abscesses, occasional drainage and curettage of sinuses. In a few cases, excision of a localized glandular mass may hasten recovery, but the extensive operations formerly in vogue are rarely advisable.

3. *Removal of Foci of Chronic Sepsis*—e.g., diseased tonsils—should be deferred until the glandular disease is well under control.

Lymphadenoma (Hodgkin's Disease) is probably an infective disease, although nothing precise is known of its cause.

Pathology.—The affected glands are homogeneous on section, showing an increase of stroma in the chronic cases. Microscopically an increase of endothelial cells, some of them multinucleated (lymphadenoma cells) is found, and eosinophiles may be prominent. The blood is normal in the early stages, but later shows moderate anæmia of the secondary type, with slight lymphocytosis. Similar changes may be found in the spleen, less often in the liver, kidneys, etc.

Signs and Symptoms.—Young adults, particularly males, are most frequently affected. Painless enlargement of a group of glands, often the cervical, is noticed, or pressure symptoms when deep-seated glands are involved. The glands are firm and remain discrete, showing no tendency to break down.

After an interval, which varies from one to several years, spread occurs to other groups of glands and to the viscera, the skeleton, the central nervous system, etc., secondary anæmia develops, and death results from exhaustion or intercurrent maladies. In the later stages intermittent bouts of pyrexia are characteristic (Pel-Ebstein fever).

Diagnosis.—(1) Lymphatic leukæmia is distinguished by the typical blood picture. (2) Lympho-sarcoma tends to infiltrate surrounding tissues, the course is more rapid, and the glands larger and softer. (3) In tuberculous adenitis certain groups of glands are

usually affected, it is more often bilateral, the glands less discrete, and suppuration occurs.

Treatment.—X-rays or teleradiation, combined with intravenous arsenic (neo-salvarsan or other preparations). The disease may appear to be in abeyance for a few years, but recurrence seems inevitable and death ensues.

Lympho-Sarcoma.—A very malignant tumour arising in lymph glands, particularly the cervical group, or the lymphoid tissue of tonsil or mediastinum. It forms a firm, rapidly-growing, painless tumour, which soon infiltrates surrounding structures, and gives rise to secondary growths in other glands or viscera.

Treatment.—Irradiation by X-rays or teleradium may produce dramatic improvement if visceral spread has not occurred. Recurrences are more resistant to irradiation.

Metastases in Lymph Glands are usually carcinomatous. In the sarcomata, glandular invasion is less common, except in lympho-sarcoma, sarcoma of the tonsil, testis, and thyroid. Malignant melanoma is also found.

CHAPTER X

INJURIES AND DISEASES OF NERVES

THERE are three classes of injury: Division, compression, and contusion.

Division of nerves may be complete or incomplete.

Complete Division (Mixed Nerve)—1. *Immediate Effects.*—Paralysis of muscles, anæsthesia, and vasomotor paralysis.

2. *Secondary Effects.*—(a) *Nerve.* On the proximal end a bulb is formed consisting of connective tissue and a large number of newly-formed nerve fibrils, coiled up in loops, which represent an attempt at regeneration (traumatic neuroma). In the distal end Wallerian degeneration occurs; the myelin is broken up and converted into oil globules, which are absorbed by the connective tissue cells. The axis cylinders degenerate and disappear; the neurilemma cells

multiply and form a fibro-cellular cord. (b) **Motor functions.** Muscular atrophy is apparent within a week or two. Deformity results from the unopposed action of unparalyzed muscles. Response to the faradic current disappears in two to three weeks, while with the galvanic current the reaction of degeneration (ACC > KCC) is evident. As long as there is any electrical response there is still hope of cure, but when response to galvanism is lost the case is hopeless. (c) **Sensation.** If a purely sensory nerve is divided, there is loss of *epicritic* sensation—i.e., appreciation of light touch, localization, and moderate degrees of temperature; and also, over a smaller area, of *protopathic* sensation, by which painful stimuli and temperatures below 20° C. and above 50° C. are recognized. Deep sensation remains, and there is appreciation of heavy and painful pressure with recognition of the positions and movements of joints and muscles. As deep sensation is carried by the motor nerves, we thus have a means of deciding whether a purely sensory or a mixed nerve has been divided. (d) **Trophic changes.** The part becomes cold and chilblains are easily produced; injuries occur readily because the normal protective sense of pain is lost, and repair is slower than usual. Atrophy of the bones and ankylosis of joints may follow.

Recovery.—When this occurs, new axis cylinders are formed either by downgrowth from the proximal end, or possibly independently from the distal portion, with subsequent union to those of the proximal end. Protopathic sensation is first restored, then motion, and lastly epicritic sensation, the latter taking from several months to two years or more, but even then is seldom complete.

Tinel's Sign.—Pressure along the course of the nerve causes tingling when the point is reached at which regeneration is proceeding.

Incomplete Division.—May result in very few symptoms, the most definite being loss of epicritic sensation, which may be accompanied by paralysis of certain groups of muscles supplied by that nerve only. In some cases burning intractable pain (*causalgia*)

is a marked feature, especially in the median and sciatic nerves; it is induced by the slightest stimulus. Trophic changes are apt to be severe, the skin becoming thin and shiny (glossy skin), the hair falls out, the nails become rough and brittle, and sweating is excessive.

Treatment of Nerve Injuries.—1. *Primary nerve suture* is the ideal. Asepsis is absolutely essential for success; tension on the united ends must be avoided and axial rotation of the nerve ends must be studiously prevented in order that the axis cylinders shall eventually occupy their appropriate relative positions in the nerve bundles. The finest catgut or silk and a small round-bodied needle are the best means of obtaining union, stitches being passed through the nerve sheath only, if possible. The line of suture should be buried in muscle tissue, or if not obtainable in fatty fascia; specially prepared amniotic tissue (amnioplastin) is the best artificial wrapping.

2. *Secondary nerve suture* is necessary when a long interval has elapsed since the injury. The nerve ends are freely exposed, the bulbs excised, and traction made so that the ends come into apposition. The limb is then put up so that there is no tension on the stitches. By displacing the nerve from its normal bed—*e.g.*, in the case of the ulna to the front of the internal condyle—and by careful adjustment of the joints, large gaps may be bridged. If the ends cannot now be brought together, it is justifiable in the upper limb to excise a portion of the humerus, in order to effect end-to-end suture, followed by bone plating. Animal nerve grafts are useless, but some degree of success has been obtained, especially in facial paralysis, by using grafts taken from the radial or other purely sensory nerve, or from a clean amputated limb. Nerve crossing has also been used; the distal or sometimes both proximal and distal ends are sutured carefully into lateral slits in a neighbouring mixed nerve, care being taken to divide not more than one-third of the diameter of the latter. Few successes even of a partial nature follow these methods.

3. *Physiotherapy*.—(a) Splints to prevent stretching of paralyzed muscles; (b) manipulation and *active* movement daily to prevent stiffness of joints; (c) massage; (d) electrical treatment: galvanic current in the form of an electric bath or sinusoidal current; (e) warmth and protection from injury.

Compression of Nerves may be due to: (a) Trauma—*e.g.*, crutch or splint pressure, faulty posture during anæsthesia; (b) involvement in scars or callus; (c) pressure of tumours or aneurysms; (d) abnormal bony outgrowths—*e.g.*, cervical rib.

Neuralgic pain, cramps, and spasm of muscles are followed by anæsthesia and paralysis. Wasting is slight and protopathic sensation is more affected than epicritic.

Treatment consists in removing the compressing cause, followed by the treatment detailed above after suture of a divided nerve.

Contusion and Rupture of Nerves.—Complete rupture is rare, as a rule only some of the fibres being torn. Blood is effused into the sheath, and disintegration of the injured nerve fibres follows. This injury usually results from fractures or dislocations. If a sensory nerve is affected, anæsthesia follows; if a motor nerve, paralysis. If the contusion is slight, tingling occurs without anæsthesia. Treatment is the same as for compression.

Neuritis.—Is either acute or chronic. The acute form is generally due to a septic wound and is comparatively rare.

Chronic Neuritis—*Causes*.—(1) Local: Injury, the presence of a foreign body or long-continued pressure. (2) General: Alcoholism, syphilis, gout, diabetes, and influenza.

Pathology.—In and around the nerve bundle there is an increase of the connective tissue, which contracts, causing atrophy and degeneration of the nerve fibres.

Symptoms.—Neuralgic pain is first noticed, with hyperæsthesia and tingling of the skin. This is followed by anæsthesia, and perhaps trophic lesions. If a mixed nerve is affected, there is at first impaired

motor power, followed by atrophy of muscles, and eventually paralysis.

Treatment.—The cause should be removed if possible, and the general health treated. Counter-irritation, massage and galvanism are sometimes effective. Morphine may have to be given for the pain. If these means fail, operative measures, such as acupuncture, nerve stretching, neurotomy, or neurectomy, are necessary.

Neuralgia.—Is a condition characterized by darting pain along the course of a nerve without any co-existing pathological changes in the nerve itself, whereas in neuritis these changes are always present. The attacks are paroxysmal and last from a few minutes to some hours.

Causes.—Predisposing causes are anæmia and debility. Exciting causes may be inflammation or foreign bodies in the neighbourhood of the nerve, pressure, or disease of the spinal cord or brain. Carious teeth, however, are the most common cause.

Treatment consists in improving the general health and applying counter-irritants or sedatives. For the pain morphine may have to be given. Antipyrin or phenacetin sometimes does good. Gout, rheumatism, or syphilis should be treated. If this medical treatment fails, the operations of neurotomy or neurectomy are necessary.

Neurotomy consists in dividing the nerve above the seat of pain, but, as union quickly occurs, it is not so efficacious as neurectomy, in which a portion of the nerve is removed. In many cases there is a centre of origin for the pain, so that in such ganglia as the Gasserian the sensory root has eventually to be divided. It has been found that injection of alcohol (80 per cent.) into the nerve trunk or ganglion is often of temporary value. In a mixed motor and sensory nerve, stretching has to be relied upon.

Affections of Special Nerves.

Olfactory (I.).—May be torn in fracture of the cribriform plate, producing loss of smell.

Optic (II.).—May be ruptured in fracture of the base of the skull, producing blindness. It may be compressed by extravasated blood, inflammatory exudates, gummata, aneurysms, or tumours, producing œdema of the fundus oculi (*papillo-œdema* or *optic neuritis*) and, if the pressure is not relieved, optic atrophy and blindness.

Oculo-motor (III.).—May be involved in central lesions, such as gumma, or peripheral lesions, such as aneurysm, tumour, or trauma anywhere in its course. Paralysis of all the muscles supplied by it follows, with ptosis, external squint, dilatation of the pupil, loss of accommodation, and diplopia. Many cases are of syphilitic origin, and improve with iodide of potassium and mercury.

Trochlear (IV.).—Paralysis causes defective movement of the eyeball downwards and outwards.

Trigeminal (V.).—Trigeminal neuralgia, or *tic-douloureux*, is characterized by paroxysmal attacks of violent pain, beginning as a rule in the second or third division, later involving both of these, and finally spreading to the first division. Hyperæmia of one side of the face, lachrymation, and twitchings may accompany the spasms of pain. The patient's condition becomes one of nearly constant agony when the attacks are frequent. There is neither sensory loss nor motor paralysis. The cause is unknown. In practically all cases no change can be found microscopically in either the Gasserian ganglion, its sensory root, or in any of its branches.

Treatment.—(a) General health should be attended to. (b) Drugs, such as croton-chloral or morphine, relieve the pain, but their effect is temporary. (c) Alcohol injection into either the Gasserian ganglion or the second or third divisions of the nerve as they emerge from the skull. 1 c.c. of 80 per cent. alcohol is injected, the skin being anæsthetized with novocain, and the greatest care taken to ensure that the needle-point is correctly placed, otherwise facial paralysis, deafness, or permanent giddiness may result. (d) Division of the sensory root of the Gasserian ganglion is the operation usually performed when other

methods have failed. More recently division of the quinto-spinal tract in the medulla has been carried out. The advantage claimed is the preservation of common sensation with loss of pain and temperature sense.

Abducens (VI).—May be ruptured by injuries, and the result is internal squint.

Facial (VII).—May be paralyzed from:

1. *Intracranial Lesions.*—(a) Injury; (b) hæmorrhage; (c) thrombosis; or (d) pressure. If the lesion is a supranuclear one—*i.e.*, in the cortex, corona radiata, or internal capsule—the opposite side of the face is partially paralyzed and hemiplegia is usually associated. If the lesion is infranuclear—*i.e.*, between the pons and the internal auditory meatus—the same side of the face is completely paralyzed and deafness is usual.

2. *Cranial Lesions.*—There are three common causes: (a) Fractured base of skull through the petrous bone, dividing the nerve, or from callus pressure two to three weeks later; (b) otitis media, causing inflammatory compression in the aqueductus Fallopi; (c) injury during mastoid operations. Paralysis is complete and on the same side.

3. *Extracranial Lesions.*—(a) Exposure to cold (Bell's palsy); (b) pressure of tumours, especially in the parotid gland; (c) injury during operations.

Signs of Facial Paralysis.—Loss of the normal facial lines on the paralyzed side and paralysis of the muscles. Epiphora (tears running on to face), from drooping of the lower eyelid and paralysis of the tensor tarsi. Marked asymmetry when the muscles of the opposite side are put into action; inability to whistle.

Treatment.—If any removable cause is discoverable, operation is called for. If not, electricity, massage, and prosthetic apparatus to prevent excessive stretching of the muscles, should be employed. If no improvement follows, nerve anastomosis may be tried, the peripheral end being joined to a part or the whole of the central end of the hypoglossal. In cases following mastoidectomy good results may be obtained by decompressing the nerve in the aque-

ductus or by the insertion of a graft by Ballance's methods when there is a gap between the nerve ends.

Facial Tic.—A clonic spasmodic state of some or all of the facial muscles, due to a nuclear or cortical lesion. If not relieved by nerve tonics, alcohol injection, nerve stretching, neurotomy or facio-hypoglossal anastomosis may be tried.

Auditory (VIII.).—May be torn in fractured base of skull, causing deafness. Part or the whole of the nerve is divided for Ménière's disease.

Glosso-pharyngeal (IX.).—Neuralgia is rare, but is characterized by pain referred to the back of the tongue, pharynx, pillars of fauces, and ear. The tympanic branch supplying the mastoid, Eustachian tube, and middle ear appears to be particularly susceptible.

Vagus (X.).—May be injured in fractured base of skull, in operations about the neck, or by pressure of aneurysms and tumours in the thorax. Unilateral injury causes paralysis of one vocal cord and hoarseness. If both nerves are divided, death speedily results from laryngeal paralysis or oedema of the lungs.

Spinal Accessory (XI.).—May be injured in fractured base of skull or operations on the neck. In the former case, paralysis of pharynx, larynx, and sterno-mastoid, with partial paralysis of trapezius, follow; in the latter, more extensive paralysis of trapezius, with wasting and drooping of the shoulder. Clonic spasm of the sterno-mastoid and trapezius (spasmodic torticollis) is due to central changes, and may require neurectomy.

Hypoglossal (XII.).—May be divided in operations or injured by the pressure of an external carotid aneurysm. Paralysis or weakness of one side of the tongue, followed by atrophy, is the result.

Spinal Nerves.

Cervical Plexus.—No serious results ensue unless both phrenic nerves (C 3, 4, 5) are divided, when death usually follows from paralysis of the diaphragm.

Excision of one phrenic nerve (phrenic avulsion) is frequently performed in cases of bronchiectasis or tuberculosis affecting the lower part of one lung, and results in partial collapse of the corresponding hemi-thorax.

Brachial Plexus.—May be injured in many ways: (a) Penetrating wounds; (b) excessive traction during delivery; (c) fractured clavicle; (d) dislocated shoulder and attempts at reduction; (e) cervical rib; (f) prolonged Trendelenburg position during operations.

Types of Injury—1. *Complete Plexus Injury*.—The whole arm is paralyzed and anæsthetic, and the pupil may be contracted on the same side. The serratus and rhomboids escape.

2. *Upper Arm Type (Erb-Duchenne)*.—The upper trunk (C 5 and 6) is injured, resulting in paralysis of deltoid, biceps, brachialis anticus, supinator longus, and most of the short muscles around the shoulder-joint (rotators). There is no loss of sensation.

3. *Lower Arm Type (Klumpke)*.—The lower trunk (C 8 and D 1) is involved, paralysis of the flexors of the wrist and fingers and of the intrinsic muscles of the hand following. Anæsthesia of the inner side of arm and forearm and hand also results.

Treatment.—Some cases recover without operation. The others give fair results if treated on the lines already laid down for nerve injuries.

Circumflex Nerve.—This may be injured in dislocations of the shoulder or fractures of the surgical neck of the humerus and by crutch pressure. Paralysis and wasting of the deltoid follow.

Musculo-Spiral Nerve.—May be injured by: (a) Fractures and dislocations of the humerus, especially fractures of the shaft; (b) crutch pressure; (c) incorrect posture during anæsthesia; (d) pressure during drunken sleep.

Results.—Paralysis of the triceps, supinators, and of the extensors of the wrist, fingers, and thumb, resulting in wrist-drop. The hand is held pronated, and the terminal phalanges only can be extended by the interossei, which are supplied by the ulnar nerve. No loss of sensation results in most cases

but if the nerve is injured very high up in the upper arm, anæsthesia follows over the back of the radial side of the hand and thumb.

Treatment.—(1) Cock-up splint, electricity, and massage; (2) nerve suture as soon as division is certain; (3) tendon transplantation if nerve suture fails. Flexor carpi ulnaris, flexor carpi radialis, pronator radii teres, and palmaris longus are joined to the extensors of the wrist, thumb, and fingers.

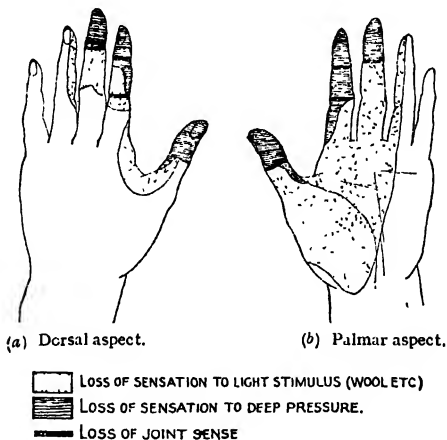


FIG. 1.—SENSORY CHANGES FOLLOWING DIVISION OF MEDIAN NERVE IN FOREARM.

Median Nerve.—Usually injured just above the wrist by broken glass, which also severs the flexor tendons. Anæsthesia of the thumb and outer two and a half fingers results both on the palmar aspect and on the dorsum of the distal phalanges. Paralysis of *opponens pollicis*, *abductor pollicis*, part of *flexor brevis pollicis*, and the outer two *lumbricals* also follows. True apposition of the thumb to the little finger is impossible, but may be mimicked by

the flexors and adductors, and wasting of the ball of the thumb is evident.

If divided at the elbow or higher, the pronators and the majority of the flexors of wrist and fingers are paralyzed.

Treatment.—Primary suture is always desirable. Secondary suture is worth trying in cases which have not been treated by primary suture or where this has failed. In all cases the prognosis is unfavourable.

Ulnar Nerve.—May be injured at the elbow or wrist by wounds, fractures, or dislocations.

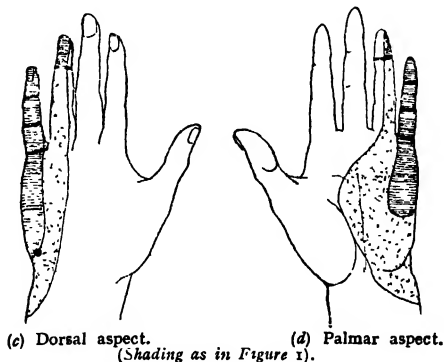


FIG 2.—SENSORY CHANGES FOLLOWING DIVISION OF ULNAR NERVE IN FOREARM.

1. *Injury at Elbow.*—Paralysis of the interossei, inner two lumbricals, adductor pollicis, and the short muscles of the little finger results. The fingers are hyperextended proximally and flexed distally (main-en-griffe) and cannot be separated from one another. Paralysis of flexor carpi ulnaris and part of flexor profundus is also present, causing weakness of grasp and radial abduction of the hand. Anæsthesia of the inner one and a half fingers and of the ulnar side of the hand, both back and front, occurs.

2. *Injury at Wrist.*—Paralysis is limited to the

hand and anæsthesia to the palmar aspect and back of the terminal phalanges only.

Treatment.—Primary or secondary suture, if necessary combined with displacement of the nerve to the front of the elbow. The prognosis is poor in all cases.

Great Sciatic Nerve.—Is seldom injured, but frequently the seat of neuralgia—*sciatica*.

Causes.—(1) Inflammation from gout, focal sepsis, injury, or exposure to cold or damp; (2) pressure by aneurysms or new growths either in the pelvis or in its extrapelvic course; (3) pressure in the spinal canal on the nerve roots from displaced portions of intervertebral disc, caries or neoplasms.

Symptoms.—Paroxysmal pain and tenderness along the course of the nerve and its branches, followed by muscular wasting. The limb is kept slightly flexed.

Treatment.—The cause must be found and if possible removed. Attention should be paid to the general health. Rest in bed, splinting to immobilize the parts, counter-irritants, and sedatives may help. Injections of sterile saline or novocain into the nerve, and in stubborn cases nerve stretching by manipulation or open operation may eventually be needed. Laminectomy is indicated when the cause is intraspinal.

External Popliteal Nerve.—Liable to injury where it lies under the biceps tendon and also near the neck of the fibula. Paralysis of the extensor and peroneal muscles, causing drop-foot, and anæsthesia of the dorsum of the foot result. Talipes equinovarus follows from the over-action of opposing unparalyzed muscles.

Internal Popliteal Nerve.—Seldom injured. Anæsthesia of the sole and paralysis of the flexor group of the ankle and toes follow, and talipes calcaneovalgus is the result.

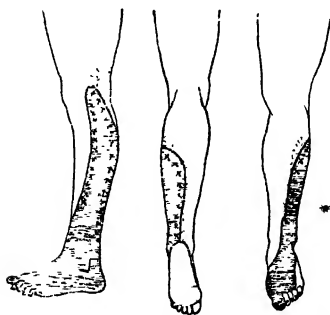
Sympathetic Nervous System.

This consists of the following parts:

1. *Trunks or cords*, one on each side, lying on the antero-lateral aspect of the vertebral column.



a) Internal. (b) Anterior. (c) Posterior.



(d) External. (e) Posterior. (f) Anterior



 LOSS OF SENSATION TO LIGHT STIMULUS (WOOL ETC.)
 LOSS OF SENSATION TO DEEP PRESSURE
 x x x LOSS OF DEEP SENSE.

FIG. 3.—(a-d) EFFECTS OF COMPLETE DIVISION OF GREAT SCIATIC NERVE; (e) AND (f) EFFECTS OF COMPLETE DIVISION OF EXTERNAL POPLITEAL NERVE.

2. *Ganglia*. Three on each side in the cervical region (upper, middle, and lower or stellate), one to each spinal segment in the dorsal, lumbar, and sacral regions.

3. *Rami communicantes*. Two on each side (white

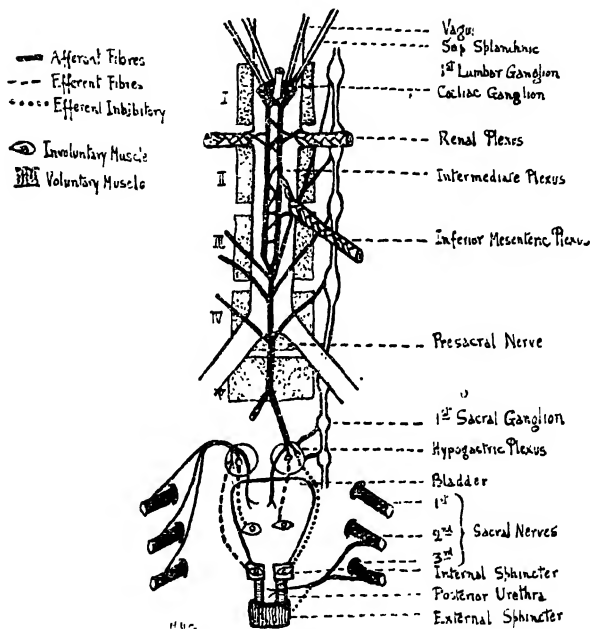


FIG. 4 —SYMPATHETIC NERVES OF ABDOMEN AND PELVIS.

and grey), connecting the ganglia to each spinal nerve.

4. *Plexuses*. Freely communicating branches arising from the ganglia and lying close to the main viscera and along the main vessels (cardiac, coeliac, and hypogastric).

The sympathetic nervous system plays an important part in the control of tone in bloodvessels and in involuntary contractions of viscera and sphincters. It is also concerned in the transmission of painful impulses arising in the viscera. The following conditions are treated by operations on the sympathetic:

1. **Raynaud's Disease.**—Excision of the stellate and of the first dorsal ganglia usually determines rapid improvement, but the effect may not be permanent.

2. **Thrombo-Ångeitis Obliterans.**—If under spinal anæsthesia there is an improvement in colour and a raised temperature of the affected limb, lumbar sympathectomy—*i.e.*, excision of the second, third, and fourth lumbar ganglia—is indicated.

3. **Megacolon (Hirschsprung's Disease).**—Promising results have followed presacral sympathectomy combined with removal of the inferior mesenteric plexus. Impotence is liable to follow this operation in the male.

4. **Intractable Visceral Pain.**—In cancer of the rectum and bladder, and for severe dysmenorrhœa, presacral sympathectomy—*i.e.*, excision of the lower part of the aortic plexus and of the presacral nerves—has been performed.

Operations on the sympathetic nervous system demand a high degree of critical judgment for their justification, as once performed they are irrevocable. There is evidence that such operations are frequently employed in unsuitable cases.

CHAPTER XI

AFFECTIONS OF MUSCLES, TENDONS, AND BURSAE

MUSCLES AND TENDONS

Contusion leads to extravasation of blood amongst the fibres, with pain on active movement. The treatment is rest for a few days, massage, and passive movement.

Rupture of Muscle Sheath occurs in the biceps cubiti, rectus femoris, rectus abdominis, and adductors of the thigh. A hernia of the muscle through the hole in the sheath takes place during contraction. Treatment consists in relaxing the muscle and keeping it at rest until the gap is healed. In old-standing cases the hole should be sutured if necessary.

Dislocation of Tendons.—This occurs rarely, the tendons being displaced from their osseo-fibrous canals—*e.g.*, the peronei as they pass under the external malleolus. Sudden pain is felt during some exertion, movement is afterwards impaired, and the tendon may be felt out of its place. If it is relaxed and replaced, and the part kept at rest for several weeks, the fibrous sheath unites, but recurrence is not unusual. It is then necessary to expose the sheath and suture it.

Rupture of Muscles and Tendons may occur from sudden excessive violent action. A flake of bone may be torn away with the tendon. Muscles commonly affected: gastrocnemius (inner head), plantaris (tennis leg), adductor longus (rider's strain), sternomastoid (during labour), biceps cubiti, tendo Achillis, ligamentum patellæ.

Signs.—The patient feels a localized pain, as if struck. Inability to use the muscle, extravasation of blood, and swelling occur. If a muscle has been torn, a gap can be felt when it is put into action; if a tendon has been torn, the muscle can be felt as a rounded tumour when contraction occurs.

Repair takes place by scar tissue, which in time may be replaced by true muscle tissue.

Treatment.—The parts must be relaxed to bring the divided ends into apposition, and kept so for three weeks. Open operation and suture is often preferable, followed by massage and active movements after a fortnight.

Myositis.—Inflammation of muscle may be classified as follows:

1. **Traumatic.**—Results from contusion or laceration, and may end in the formation of fibrous tissue, contraction, and deformity.

2. *Rheumatic (Fibrositis)*.—Occurs in middle-aged people, often following exposure to cold or wet; dental sepsis is a frequent cause, and many cases show signs of gout.

3. *Suppurative*.—Is due to infection from wounds, extension from suppuration in adjacent structures, or auto-infection in pyæmia. Deformity may follow from contraction of scar tissue.

4. *Tuberculous*.—Usually secondary to bone or joint disease—e.g., psoas abscess in disease of the spine.

5. *Syphilitic*.—Occurs in the tertiary stage, and either diffuse sclerosis or gumma formation results. The tongue and sterno-mastoid are most frequently affected.

6. *Parasitic*.—Is found in infection by *Trichina spiralis* and also in hydatid disease.

7. *Myositis Ossificans*.—A rare disease, usually of young males, in which progressive ossification occurs in muscles, producing extensive ankylosis. The cause is unknown and treatment of no avail.

Traumatic Myositis Ossificans occurs in two forms: (1) Following repeated slight trauma, as in the adductor longus, where a localized bony mass develops known as 'rider's bone'; (2) following severe injuries and associated with fracture or dislocation, especially in the region of elbow or knee; ossification occurs in the brachialis anticus or quadriceps and tends to spread, especially if the parts are moved soon after the injury. Prolonged rest is essential to avoid this, and at a later date excision of bony plaques may have to be carried out.

Tumours.—Primary growths are rare, comprising angioma, fibroma, myxoma, lipoma, chondroma, and sarcoma. Treatment consists of shelling out simple tumours; if malignant, removal of the whole muscle. Secondary deposits of carcinoma and sarcoma also occur.

TENDON SHEATHS

Tenosynovitis.—The following varieties occur:

1. *Acute Simple* follows strains, sprains or over-use, most commonly in the extensors of the thumb

and peroneal muscles. A tender swelling occurs along the tendon, with pain and fine crepitus on movement. Rest and hot fomentations form the early treatment, massage and movements the later.

2. *Acute Suppurative* is due to infection through wounds or spread from neighbouring tissues. The hand is most often affected (see p. 389).

3. *Chronic Simple* is due to persistent over-use. Painless effusion into the sheath occurs, with crepitus on movement. Rest, firm pressure and massage are indicated, and in obstinate cases aspiration or open incision, washing out the sac, and resuture.

4. *Tuberculous*.—The most frequent site is the wrist. Two distinct types occur: (a) Doughy swelling due to pulpy granulation tissue containing caseous foci; (b) passive effusion, often containing detached portions of fibrin (melon-seed bodies) in large numbers. A painless fluctuating swelling results with a characteristic crepitus. Prolonged immobilization and general measures to increase the resistance, including sanatorium treatment, may need to be supplemented by aspiration or open evacuation with immediate closure.

Ganglion.—A cystic swelling containing glairy fluid and arising in connexion with a tendon sheath or joint. The wrist, both back and front, and the foot are the common situations. A smooth, firm, elastic swelling appears, slightly movable from side to side; it is painless. It may arise from herniation of the synovial membrane or mucoid degeneration of fibrous tissue. Treatment consists of aspiration, with or without injection of sodium morrhuate 5 per cent. or 10 per cent., or open operation with as complete excision of the sac as possible.

Compound Palmar Ganglion.—Tuberculous synovitis of the flexor tendon sheaths at the wrist. It forms a painless, fluctuating swelling which is felt above and below the annular ligament, and may extend along the thumb and little finger. Later, finger movements are impaired and suppuration may follow. If prolonged rest and general treatment fail, evacuation with immediate closure or excision of

the sheaths must be resorted to, but stiffness from adhesion of tendons will probably remain.

Stenosing Tenovaginitis.—A condition of fibrous thickening of the tendon sheaths of the short extensors of the thumb. It generally occurs in women of about thirty-five years of age engaged in household work. The patient complains of pain on movement and a tendency to drop things. There is an obvious swelling over the styloid process of the radius, and abduction of the thumb causes sharp pain. Partial excision of the thickened sheath effects a cure.

Tumours.—Simple giant-cell tumour occurs in the finger, or at the wrist or heel. It forms a small yellow and red lobulated tumour, which should be excised.

BURSÆ

Bursæ occur normally in many parts exposed to pressure. Adventitious bursæ may be formed as the result of abnormal pressure due to occupation or deformity—e.g., over the vertebra prominens in Covent Garden porters.

Bursitis.—May be acute or chronic, the acute form being either simple or suppurative.

Varieties.—1. *Acute Simple* is due to contusions, especially in gouty and rheumatic subjects. Effusion of serous fluid into the sac, together with pain, tenderness, and increased heat, are the signs. Treatment consists of rest and fomentations, and, if these fail, excision of the bursal sac.

2. *Acute Suppurative* is due to a wound or to auto-infection of a chronically inflamed bursa. All the signs of an abscess are present, and the pus may spread beyond the bursa. Treatment consists of free incision and drainage.

3. *Chronic* may follow the acute form or be chronic from the beginning. The usual cause is repeated slight injuries, such as by kneeling on the prepatellar bursa (housemaid's knee). In the early stages the bursa is merely distended with fluid, but later lymph is deposited on its walls, which may become very much thickened. Adhesions may form

across the cavity, so that it becomes loculated. Melon-seed bodies may develop if flakes of lymph become detached. The best course is complete excision of the bursa. If this is declined, rest and counter-irritation should be tried.

4. *Tuberculous*.—Two forms occur, in one of which there is a thickening of the walls and effusion containing melon-seed bodies; in the other there is pulpy, caseous granulation tissue filling the sac and ending in the formation of a tuberculous abscess. Both forms may or may not be secondary to tuberculous disease of a joint. Treatment consists of excision if possible; if not, free incision, curettage, and suture.

5. *Syphilitic* occurs in the secondary stage as a symmetrical effusion; in the tertiary stage a gummatous deposit may take place.

6. *Gouty*.—Most frequently found in the olecranon bursa and due to deposits of urates in the bursal wall; suppuration may follow.

Tumours.—Sarcoma and myxoma rarely occur, and should be completely removed.

Special Bursæ.—Those which are commonly affected: (1) Bursæ around the knee. (*a*) Prepatellar, lying over the lower half of the patella and upper part of the ligamentum patellæ; (*b*) the bursa which lies between the ligamentum patellæ and the tubercle of the tibia, and projects when distended on either side of the ligament during extension of the knee; (*c*) semimembranosus bursa, which projects into the popliteal space from under the semimembranosus tendon, is tense during extension, flaccid on flexion of the knee, and may communicate with the joint; (*d*) semitendinosus bursa. (2) The tendo Achillis bursa, the psoas, the gluteal—situated between the insertion of the gluteus maximus and the great trochanter—the bursa over the tuber ischii, the olecranon and subdeltoid bursæ.

CHAPTER XII

SURGICAL DISEASES OF THE SKIN

Acute Infections.—(a) Boils and carbuncles are described on pp. 16-17.

(b) *Impetigo contagiosa* is due to a streptococcus, and usually affects the face in children. Pustules develop and burst, the pus drying into yellow crusts. The condition is cured by removing the crusts with hydrogen peroxide and applying ung. hydrarg. ammon. dil. twice daily or sulphonamide powder.

Tuberculosis.—This may affect the skin in several ways:

1. **Lupus Vulgaris.**—A chronic tuberculous inflammation of the skin and mucous membranes. It occurs in children and young adults, usually affecting the nose and cheeks, less often the trunk and limbs.

Signs.—Shotty, brownish-yellow (apple-jelly) nodules appear surrounded by an area of hyperæmia; infiltration and ulceration follow. Healing occurs in one part while spread is taking place at another. Typical miliary tubercles can be seen microscopically. The disease is painless and very chronic, often ending spontaneously, but destruction of bone and cartilage may occur, or epithelioma supervene.

Diagnosis.—Lupus must be distinguished from tertiary syphilis, rodent ulcer, and epithelioma. Pressure with a glass spatula on the edge of the affected area will usually reveal the typical apple-jelly nodules; the age at onset and the chronicity will also serve to distinguish it.

Treatment.—X-rays, Finsen light, and ultra-violet light (carbon arc) are all employed successfully. In some cases curetting and application of caustics or diathermy are of use. Excision followed by skin grafting is indicated in strictly localized areas without bone or cartilage involvement.

2. **Bazin's Disease** (erythema induratum) is usually seen in girls and young women. The skin of the back of the leg becomes thickened and purplish, and nodules

can be felt. Some of these nodules break down, leaving typical tuberculous ulcers. The lesions are usually bilateral.

3. **Verruca Necrogenica** (butcher's wart) is the result of direct implantation of tubercle bacilli into the skin. The fingers, hand or forearm is the usual site. First a papule is noticed and later it develops into a purplish warty growth with an indurated area around. Excision is advised.

Syphilis.—This is described in Chapter IV.

Erythema Pernio (Chilblain).—This is common in children and young adolescents, more so in females. Painful and indurated areas appear on the fingers, toes, hands, or feet following exposure to cold. The skin is reddened or purplish. Vasomotor spasm is a factor, and the available evidence indicates a diminished blood calcium associated with parathyroid deficiency. Locally the parts should be painted with tincture of iodine and collodion. Sinusoidal baths are also of value. Calcium lactate and parathyroid extract may be given for prophylaxis.

Corn.—This consists of hypertrophied layers of the epidermis surrounding a central hard, horny plug, which compresses and causes atrophy of the papillæ of the dermis. Abnormal pressure by badly-fitting boots is the usual cause. Corns are hard unless situated in moist situations—*e.g.*, between the toes (soft corns).

Perforating Ulcer.—The usual site is the foot. It is due to some persistent slight injury, as from tight boots, which has been ignored owing to associated anæsthesia. It occurs, therefore, in (1) tabes dorsalis, spina bifida, syringomyelia; (2) peripheral neuritis from diabetes, alcoholism, and syphilis; (3) traumatic affections of sensory nerves. The commonest site is under the head of the first metatarsal bone. A deep septic ulcer is formed, surrounded by thickened epidermis and extending to the bones or joints. This may necessitate amputation if other measures fail.

Molluscum Contagiosum.—Small, firm, umbilicated nodules appear on the skin, usually of the face.

The disease is apparently contagious. The nodules consist of wedge-shaped lobules of polygonal nucleated epithelial cells supported by a fibrous stroma. The cells towards the centre undergo hyaline degeneration and contain rounded bodies resembling psorosperms. Treatment consists of snipping off the nodules.

Neoplasms—1. **Innocent:**

Papilloma.

Sebaceous adenoma.

Simple melanoma.

2. **Malignant:**

Rodent ulcer.

Squamous carcinoma.

Sebaceous carcinoma.

Malignant melanoma.

Papilloma.—This may be single or multiple.

(a) **Single Papilloma.**—This usually affects the face, neck, or extremities. The surface may be rough or smooth, and the growth may appear as a flat plaque or a raised nodule which may even be pedunculated. Growth is sometimes rapid and ulceration not uncommon. Treatment is by wide excision or low-voltage near-distance X-ray therapy.

(b) **Multiple Papillomata.**—Several types of 'warts' occur:

1. *Idiopathic.*—These are common in children, affecting the hands and face. The incidence in several members of one family or concurrently in playmates indicates their contagious nature. Spontaneous cure is not uncommon. Removal by diathermy or low-voltage near-distance X-ray therapy is recommended.

2. *Pitch Warts.*—Crops of papillomata may be seen on the hands, forearms and face of workers in pitch and tar. They eventually become malignant unless treated. Low-voltage X-ray therapy effects a cure.

3. *Venereal.*—In gonorrhœa the penis or vulva may be the seat of multiple soft warts. Excision by diathermy is sometimes called for.

Sebaceous Adenoma.—The scalp is the usual site. A firm rounded tumour develops slowly and may ulcerate. Excision is called for.

Simple Melanoma (Pigmented Mole).—This may be single or multiple. The surface is usually raised and sometimes covered with hairs (hairy mole). Malignant transformation is liable to follow at any time. Excision is called for either for cosmetic reasons or when the tumour is exposed to repeated trauma.

Rodent Ulcer.—This is the usual term for basal-celled skin carcinoma. Most cases occur in patients over sixty years, and men are more frequently affected. Exposure to strong sunlight over a prolonged period is apparently an ætiological factor, and therefore gardeners and agricultural workers are specially susceptible. The upper half of the face and the front and sides of the scalp are the usual sites, and multiple growths are not uncommon. Further details will be found on p. 71.

Squamous Carcinoma (Epithelioma).—This may arise *de novo* or from malignant change occurring in (a) single papilloma, (b) pitch warts, (c) lupus vulgaris, (d) callous ulcers, (e) scars. Chronic irritation is an important factor in many cases. Further details will be found on p. 70. Low-voltage near-distance X-ray therapy is the most effective treatment in most cases.

Sebaceous Carcinoma.—This usually presents itself as a soft raised growth increasing rapidly in size, but slow to infiltrate lymph glands. Low-voltage therapy is called for.

Malignant Melanoma.—This frequently arises from malignant change in a simple melanoma, usually as the result of irritation. Widespread metastasis by both lymphatic and blood stream may occur rapidly, although there may be little visible increase in size of the original growth. Absence of melanin in the primary tumour does not preclude its presence in the secondary deposits, and *vice versa*. Excision of the growth and the regional lymph glands is called for, but many cases die of recurrence within a year.

Cysts.—(a) *Sebaceous*, (b) *implantation dermoid*.

(a) **Sebaceous Cyst** is due to obstruction of the duct of a sebaceous gland, and, though common on the

scalp, may occur on any part of the skin. It forms a rounded, elastic swelling movable on the deep structures, and always adherent to the skin at one spot. Often the mouth of the follicle can be seen and sebaceous material expressed. The cyst wall consists of fibro-cicatricial tissue lined by epithelium; the contents are sebaceous matter, which may ooze out and dry on the surface, forming a sebaceous horn. Suppuration is common in these cysts; rarely exuberant sprouting granulations may follow rupture and be mistaken for epithelioma (Cock's peculiar tumour).

Diagnosis.—Dermoid cyst is limited to certain localities and not attached to the skin. Cold abscess has no pore, appears more rapidly and may extend deeply. Lipoma is lobulated, more movable and may not be adherent to the skin.

Treatment.—If large or giving trouble, the cyst should be dissected out. This is simplified by emptying it and then removing the wall.

(b) **Implantation Dermoid.**—Arises from epithelium which has been displaced subcutaneously, either from operation or injury. The hand or finger is often affected. Excision is required.

The Nails.

Onychia, Perionychia, or Paronychia.—Inflammation of the nail matrix may be due to pyogenic organisms or to syphilis. Septic onychia is accompanied by severe throbbing pain. The suppuration spreads under and loosens the nail. The latter must be removed over the region affected, the granulation tissue curetted, and hot fomentations or baths employed. Syphilitic onychia occurs in the secondary stage of acquired syphilis and also in the congenital form. Antisyphilitic treatment cures the condition.

Ingrowing Toe-nail is not due to actual ingrowth, but to ulceration of the soft parts, which curl over the edge of the nail, usually of the big toe, owing to the pressure of tight boots. Septic infection supervenes and onychia may result. In the early stages

cure may be brought about by cleanliness, by tucking under the nail edge a strip of tinfoil, and the use of square-toed boots. In later cases, half of the nail should be removed as well as the soft tissues overhanging it.

Glomus Tumour (Glomangioma).—A tumour of small size, purplish colour, slow growth and innocent character occurring in the nail bed or the skin of the extremities. It is associated with paroxysms of severe pain. Excision is called for.

CHAPTER XIII

DISEASES OF BONE

Osteitis.—Inflammation of bone may be acute or chronic. It is usual to differentiate *periostitis* when the periosteum is mainly affected from *osteomyelitis*, in which the condition mainly involves the medullary cavity.

Epiphysitis is inflammation of an epiphysis.

Owing to the special structure of bone, inflammation, which always commences in the vascular parts, is liable to be followed by certain results peculiar to the mineral portion. The exudation which occurs in acute inflammation causes increased pressure in the rigid bony canals, with the result that the blood supply is cut off, portions of bone dying *en masse* (*necrosis*); the dead portion is termed a sequestrum. In less acute inflammations, uniform absorption of the bony lamellæ and the mineral salts takes place (*caries* or *rarefaction*), or in some cases condensation of bone occurs (*osteosclerosis*).

Necrosis may result from: (1) Acute suppurative periostitis (exfoliation); (2) acute infective osteomyelitis; (3) tuberculosis of cancellous bone; (4) syphilis; (5) chemical substances—*e.g.*, mercury or phosphorus; (6) gangrene; (7) injury (quiet necrosis); (8) radium or X-ray therapy.

Caries is found in: (1) Acute or subacute infections of cancellous bone; (2) tuberculous disease; (3) syphil-

itic disease. It may occur without suppuration (caries sicca) or in conjunction with necrosis (cario-necrosis).

Sclerosis always results from chronic inflammation, and is found in: (1) Chronic periostitis, simple or syphilitic; (2) chronic osteomyelitis, simple, tuberculous, or syphilitic; (3) chronic osteitis of compact bone.

Acute Localized Periostitis may be caused by: (1) Trauma; (2) extension from a neighbouring focus—*e.g.*, alveolar abscess; (3) X-rays or radium; (4) gout; (5) specific fevers; (6) pyæmia.

Pathology.—Hyperæmia and exudation occur, and, if of mild degree, the process ends in resolution or organization (simple periostitis). In most cases the pressure of the exudate produces thrombosis and lifts the periosteum, rupturing those vessels passing to the underlying bone. The latter undergoes necrosis, while suppuration is taking place under the periosteum (suppurative periostitis). The pus bursts through this membrane, and, as soon as tension is relieved, repair begins. The dead bone if very small may be completely absorbed. Otherwise separation takes place by a process of rarefaction between it and the living bone; meanwhile, a shell of new bone, the involucrum, is being formed on the under surface of the stripped-up periosteum, and in this involucrum one or more holes (cloacæ) develop, through which pus escapes.

Signs and Symptoms.—Those of acute inflammation. Pain is severe, worse at night, and increased by lowering the limb or by pressure. If the bone is superficial, redness and œdema are soon apparent, followed by fluctuation. After the abscess bursts or is opened, bare bone is felt at the bottom of the sinus. The sequestrum takes from six to twelve weeks to separate, and skiagrams are of use in deciding when this process is complete.

Treatment.—Rest, elevation of the limb, hot fomentations and Bier's hyperæmia in the early stages; if pus is suspected, an incision down to the bone will relieve the tension, and prevent or limit

necrosis. When the latter has occurred, the wound must be dressed antiseptically until the sequestrum is loose; this may then be removed and healing of the cavity by granulation promoted.

Acute Infective Osteomyelitis.—Acute inflammation of bone, met with most often in children, in boys more than girls, but also affecting adults. Predisposing conditions are general debility, exanthemata, impetigo, septic foci in the mouth or throat, but in many cases the patient appears to have been in normal health when attacked. Sometimes a history of slight trauma, such as a fall, twist or scratch, can be elicited; this is thought to play a part by producing conditions favourable to bacterial infection—*i.e.*, extravasation of blood and thrombosis in the soft bone adjoining the epiphysis. The responsible organism is usually *Staphylococcus pyogenes*, but the *Pneumococcus*, *Streptococcus* or *Bact. coli* is the cause in some cases.

Pathology.—The disease usually starts in the soft vascular tissue of the metaphysis in children, but in adults this localization does not obtain. The lower ends of the femur and radius, the upper ends of the tibia and humerus are the commonest sites. Exudation, thrombosis of vessels, stripping-up of periosteum and bacterial toxins are the main causes of necrosis. The process tends to spread rapidly along the medullary cavity and outwards through the periosteum into the surrounding muscles and cellular tissue. The avascularity of the epiphyseal cartilage and the firm attachment of the periosteum to the edges of the epiphysis usually prevent spread *via* the epiphysis into the neighbouring joint, except in young children. Infection may, however, reach the joint if the epiphyseal cartilage is intra-articular—*e.g.*, hip and elbow—or by extension along the soft tissues, and septic arthritis results. Separation of the epiphysis and subsequent interference with growth may follow. Staphylococcal bacteræmia of varying degree, demonstrated by quantitative blood cultures, is usually present, and is responsible for pyæmia and a fatal result in 20 to 30 per cent. of cases.

Once the infection has been overcome, separation of dead bone takes place, and an involucrum with cloacæ is formed. Separation of the sequestrum takes from six weeks in the case of the small bones up to three months or more in the femur.

Signs and Symptoms.—The onset is often sudden, with a rigor, high temperature, and severe pain in the affected part (usually near a joint). At this stage there is only one local sign—*i.e.*, deep-seated tender-

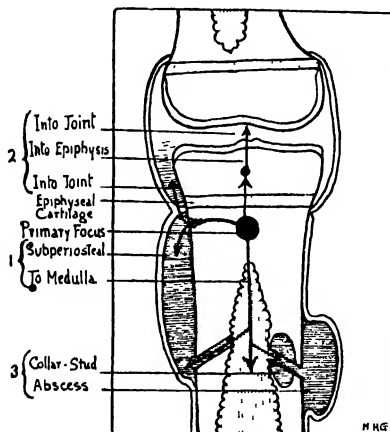


FIG. 5.—THE SPREAD OF OSTEOMYELITIS (DIAGRAMMATIC).

1, Common; 2, uncommon; 3, rare.

ness along the bone. Later, toxæmia is a marked feature, the tongue dirty, pulse rapid and soft, and the mental condition such that pain is not always prominent. If the bone is superficial, œdema appears and fluctuation follows. Fluid may be present in the neighbouring joint, which becomes disorganized. Later still, if the patient survives, pericarditis, septic arthritis in other joints, and signs of pyæmia appear.

Diagnosis.—Early diagnosis is of the greatest importance, and can only be arrived at by very careful examination. In the early stages, localized bone tenderness is the only constant physical sign. Acute rheumatism and other varieties of arthritis cause difficulty; in them the condition may be multiple, maximum tenderness is over the joint, and rapid improvement may follow the administration of salicylates.

Treatment.—This should be directed towards (1) toxæmia, (2) bacteriæmia, (3) the local lesion.

(1) *Toxæmia.*—Antistaphylococcal serum with a high antileucocidin content should be given intramuscularly in doses of 25 to 50 c.c. Ample fluids containing glucose are indicated.

(2) *Bacteriæmia.*—Repeated quantitative blood cultures are of value in estimating the degree. Sulphathiazole should be tried, but the results are often disappointing.

(3) *The Local Lesion.*—Immobilization and relief of tension are essential. Aspiration or drainage of a subperiosteal abscess may suffice, but with well-marked signs of intra-osseous tension and toxæmia free incision of the periosteum and drilling of the bone are required. The wound is gently packed with vaselined gauze and the part immobilized by fixation in plaster-of-Paris (Winnett-Orr's method). Careful watch should be kept for signs of arthritis of the neighbouring joint, and if it occurs repeated aspiration is called for.

Repeated blood transfusions are often needed in the later stages of the disease. When the infection has been overcome operation may be needed for removal of sequestra and for 'saucering' (see p. 131).

Amputation early in the disease may be a life-saving measure if symptoms of pyæmia appear and the patient is rapidly losing ground. In general, however, treatment should lean to the conservative side.

Acute Traumatic Osteomyelitis.—Follows infected compound fractures, amputations or bone operations. The wound becomes septic, accompanied by acute pain and a high temperature. Rigors and signs of

pyæmia may follow. Bare bone may be seen or felt, and later a sequestrum forms and separates. Free drainage of the wound is needed, or possibly amputation if pyæmia supervenes.

Chronic Periostitis.—May be due to trauma, infection by pyogenic organisms or *Bact. typhosum*, gout, focal sepsis and syphilis. Organization of the exudate results in new periosteal bone formation, which may give rise to a localized projection termed a *node*.

Chronic Osteomyelitis.—The result of infection by low-grade pyogenic organisms or *Bact. typhosum*. Sclerosis, rarefaction or necrosis of bone may supervene, or in certain cases localized suppuration, producing a *Brodie's abscess*. In the latter condition, which is most common in the upper end of the tibia or the lower end of the femur, the onset is insidious, but eventually pain and swelling develop. Skiagrams show an area of rarefaction enclosed by a zone of more or less sclerosed bone.

Signs and Symptoms.—Dull aching pain, which is increased at night, with tenderness over the affected bone. The bone itself is thickened, either diffusely or over a localized area. The symptoms may subside for a time, but exacerbations are frequent, especially in the case of Brodie's abscess.

Treatment.—Rest, counter-irritation and potassium iodide in large doses may be tried. In severe cases with much pain the periosteum should be incised and stripped back, the medullary cavity opened freely, and if pus is found, the wound drained. If not, the wound should be closed. If healing fails to occur in any chronic bone abscess or cavity, it may be necessary to cut away the edges of the bone freely, and to stitch musculo-cutaneous flaps into the shallow cavity resulting (*saucerizing*).

Osteochondritis or Epiphysitis.—These terms are used to describe a condition which may affect any epiphysis and of which the cause is still disputed. Trauma is an important factor, but there are several facts supporting the theory that low-grade infection is responsible.

Signs and Symptoms.—The onset is gradual and the patient, usually a boy in good general health, complains of pain in the affected part. There is generally a history of slight injury. If a weight-bearing joint is involved, there is limitation of movement and muscle spasm. Skiagrams show broadening of the epiphyseal line and areas of rarefaction and condensation in the epiphyseal nucleus, giving a hazy, mottled appearance.

Special Situations — 1. *Pseudo-coxalgia (Perthes' Disease, Legg's Disease, Calvé's Disease).*—The epiphysis of the head of the femur becomes fragmented, flattened and mushroomed, with shortening of the neck. Boys between three and twelve years are usually affected; the onset is gradual, with slight pain and limp. Movements are limited at the hip-joint, especially internal rotation and abduction, and skiagrams show fragmentation and abnormal shape of the epiphysis, but, unlike tubercle, the bone is of normal density and the edges are sharply defined. There is a strong tendency to spontaneous recovery, but immobilization in plaster is usually advisable.

2. *Schlatter's Disease.*—Occurs in children and involves the junction of shaft and upper epiphysis of the tibia in the region of the tibial tubercle. Tenderness and swelling are found, often in company with a limp, and skiagrams show an apparent displacement of the epiphysis, with irregularity of the margins.

3. *Köhler's Disease.*—The tarsal scaphoid is enlarged and tender. Increased density, antero-posterior shortening and increased breadth of the ossific centre are seen in skiagrams. Children between the ages of three and six, usually boys, are affected.

4. *Kienböck's Disease.*—Affects the carpal semi-lunar; X-ray appearances similar to Köhler's disease are found. Trauma plays an important part in some cases.

5. *Apophysitis of the Os Calcis.*—Enlargement of the heel occurs, accompanied by pain, skiagrams showing apparent separation and sometimes fragmentation of the epiphysis at the back of the os calcis.

Treatment.—In all these conditions, prolonged

rest and protection from injury usually result in a cure.

Tuberculosis.—Tuberculous disease of bones mainly affects young people, being frequently secondary to disease of the bronchial or mesenteric glands.

Pathology.—Tubercles and granulation tissue form, followed by caseation and abscesses, either under the periosteum or in the medullary cavity, or both. The bony tissue of the affected area may be absorbed slowly (*caries*), while the bone around it becomes denser than normal (*sclerosis*). Sequestra may form, particularly in adults, the dead tissue being soft and friable, and permeated by caseous material, giving it a yellowish-white colour.

In some bones the process affects mainly the periosteum, in others the cancellous tissue; in the case of the long bones, the part involved is usually near one extremity, but occasionally, in adults, the medullary canal of the shaft is the main site of the disease.

1. **Tuberculous Periostitis.**—This is the type usually met with in the ribs, sternum and vertebræ, often forming abscesses which track for long distances along muscular or fascial planes. The underlying cancellous bone is frequently diseased, and caries results. In the case of dense bone mere superficial erosion is to be expected.

2. **Tuberculous Osteomyelitis.**—Certain sites are especially susceptible:

(i.) *Phalanges (Dactylitis).*—Debilitated children, recovering from the exanthemata, are liable to develop fusiform swelling of a segment of one or more digits, followed by redness and abscess formation. The interior of the phalanx is carious, containing tuberculous caseous material, the periosteum thickened, and the shaft apparently expanded. In reality, new bone has been laid down under the periosteum and absorption of the original shaft has taken place. Tendon sheaths and joints are sometimes involved by extension of the disease.

(ii.) *Tarsal Bones.*—The process is similar to the above, but extension to the joints is more common.

The os calcis, astragalus (head) and scaphoid are the bones most often involved. The affected parts are swollen, movement is limited, pain is trivial, but abscesses and sinuses often follow.

(iii.) *Long Bones*.—Usually the disease begins in the epiphysis, less often in the metaphysis. The epiphyseal cartilage is frequently destroyed, and the process spreads to the adjacent joint either by perforation, erosion or necrosis of the articular cartilage, or by extension to the synovial membrane. The epiphysis may become separated or an abscess may develop in the end of the shaft.

Treatment.—Remedial measures directed to the general health should be combined with immobilization of the affected part for a prolonged period. Aspiration of abscesses, curettage of sinuses and, if possible, removal of the affected portion of bone are indicated. In neglected cases with secondary infection, amputation may be the only recourse.

Syphilis.—May give rise to any of the following conditions:

1. *Osteoscopic Pains*.—In the secondary stage vague pains occur in various bones, but disappear with anti-syphilitic treatment.

2. *Periostitis*.—Found in both the late secondary stage and in inherited syphilis. It usually affects the shaft of one long bone, most often the tibia, but may be bilateral. Subperiosteal new bone is laid down, either in a localized area (node) or diffusely over the whole shaft. Tenderness on pressure and aching pain, worse when the part is warm, are present in the acquired form of the disease; the inherited type is painless, and affects long bones, particularly the tibia, and the skull (Parrot's nodes).

3. *Diffuse Osteitis*.—New periosteal bone formation and endosteal thickening may occur over the greater part of a bone, not only in acquired but also in inherited syphilis. The bone affected, most often the tibia, becomes thickened, elongated and sclerosed, the medullary canal being narrowed. Forward bowing takes place, mainly in the middle of the shaft, the anterior edge being rounded (*cf.* rickets).

4. **Gumma Formation.**—Occurs in three ways:

(i.) *Localized Gumma.*—This may be subperiosteal or endosteal. The subperiosteal gumma is not uncommon in the sternum, clavicle, ribs, palate and nasal septum, but may also occur in long bones; a painless, rounded swelling appears, which may soften and burst, leaving a typical tertiary ulcer. The endosteal gumma may commence either in the epiphysis or in the end of the diaphysis of long bones.

(ii.) *Diffuse Gummatous Infiltration (Worm-eaten Skull).*—In acquired syphilis the skull may be affected, resulting in large eroded areas and sequestra surrounded by sclerosed bone.

(iii.) *Central Gummatous Infiltration.*—This is found in the inherited disease, the phalanges, metacarpals and carpals becoming expanded by gummatous material within; sinuses follow if the skin gives way. The term *dactylitis* is applied to the form affecting the phalanges, the fusiform swelling which results being difficult to distinguish from tuberculous dactylitis.

5. **Epiphysitis.**—Occurs in young children under three months, may be multiple, and is usually found in the epiphyses near the knee or elbow, less often near the wrist. The epiphyseal cartilage may be destroyed, and spontaneous separation of the epiphysis follows. Swelling and tenderness are the main signs.

6. **Craniotabes.**—In inherited syphilis, in the first six months of life, localized absorption of the bones of the skull sometimes takes place, giving rise to a sensation of crackling on palpation; the parietal is most often affected.

Rickets.—A deficiency disease, which usually commences in the first two years of life, and is characterized by changes in the bony tissues as well as by various internal disorders.

Causes.—Three factors are concerned: (i.) Deficiency of vitamin D in the diet; this substance is present in good milk, eggs, butter and cod-liver oil, the latter having a very high content; the amount in milk is greater if the cow has fresh fodder and lives in sunshine. (ii.) Deficiency of sunlight, especially of

ultra-violet rays. (iii.) Deficiency of calcium and phosphorus; a diet with excessive carbohydrates or cereals conduces to this.

In most cases improper feeding, too much carbohydrate and too little or unsuitable fats, lack of fresh air and sunshine combine to produce the disease.

Pathology.—There is excessive preparation for the formation of new bone, but the ossifying process is inefficiently carried out; the epiphyseal line is thus very much thickened and increased in breadth as well. In addition, the tissue in the Haversian canals and medullary spaces is increased, while the dense bone is less than normal, so that the bones readily bend under the weight of the body and from the pull of muscles.

Signs and Symptoms.—May be divided into the early or general, and the later or osseous.

1. *General.*—Gastro-intestinal irritation, pallor of the mucous membranes, general flabbiness, sweating of the head during sleep, and enlargement of the spleen. Convulsions, tetany, and laryngismus stridulus are common complications.

2. *Osseous.*—Indicated by the child kicking off the bedclothes, because the bones of the leg are tender. The articular ends of the long bones and the junction of the ribs with the costal cartilages become enlarged. Later the shafts of the long bones bend, and deformities are produced. The head appears square in shape, and bosses form on the frontal bones. The fontanelles remain open longer than usual, the teeth erupt late, and may be stunted or notched. The spine may be kyphotic or scoliotic from habitual maintenance of a faulty position. Beaded ribs are always present (rickety rosary), and if there is any obstruction to the entry of air into the chest, the ribs may be pushed inwards by atmospheric pressure, so that the sternum is prominent (pigeon breast). The pelvis is flattened, and the long bones are curved so that genu valgum or varum is common, as well as antero-posterior curvature. As the acute stage passes off the bones become ossified in the deformed position.

Treatment.—(1) Diet. Good cow's milk, diluted and mixed with lime-water if necessary, raw meat-juice,

cream and eggs. (2) Fresh air and sunshine or ultra-violet light. (3) Cod-liver oil or irradiated ergosterol. (4) Prevention of deformities by recumbency, manipulation, splints and bandaging. (5) Correction of deformities. Osteotomy may be needed after the acute stage has passed.

Adolescent Rickets.—Appears at about puberty, mainly in the lower extremities, with enlargement of the epiphyses and deformity of the leg bones. Treatment consists in improving the general health, rest, cod-liver oil and sunshine, with correction of deformities by apparatus or operation.

Infantile Scurvy.—Occurs in children of four to eighteen months, from the use of food which has been deprived of its essential qualities by such methods as peptonization or boiling. The onset is often sudden, with pyrexia, tenderness of limbs, swellings of the long bones, especially the femur and tibia, from subperiosteal hæmorrhage; spongy gums, epistaxis, hæmaturia, or blood-stained diarrhoea may also be present. Separation of the epiphyses or spontaneous fractures may occur, and signs of rickets are sometimes found (scurvy rickets). Treatment by fresh milk, fruit juices and fresh vegetables, with rest to the affected limbs, effects a rapid cure.

Osteomalacia.—A deficiency disease endemic in wide areas of India and the East, occurring sporadically in central Europe but rare in Great Britain. It is due to deficiency of vitamin D and lack of calcium in the diet. It is almost entirely limited to females, and often commences during pregnancy. Bony tissue, both compact and cancellous, is absorbed and replaced by vascular fibro-cellular tissue, which also fills the medullary cavity. The bones become soft, bending and spontaneous fractures occur, emaciation and exhaustion follow, and tetany is common. The blood calcium and blood phosphorus are diminished. Recovery has occurred at the menopause or after lactation is completed.

Treatment.—Cod-liver oil, sunlight, and irradiated ergosterol often bring about a cure.

Achondroplasia.—A congenital condition in which

there is defective growth on the shaft side of the epiphyses of the long bones, resulting in dwarfing. The base of the skull is also affected, producing a characteristic facies. Treatment is of no avail.

Osteitis Deformans.—A disease of unknown origin, usually affecting middle-aged men, and either confined to one bone such as the tibia or femur, or more frequently involving many. Painful overgrowth of the long bones, spine, cranium, and pelvis, is accompanied by bone-softening. The head may increase in size, the spine becomes bent (kyphosis) and rigid, the shoulders round and the gait awkward and slow, the leg bones being bowed forward and outward. The progress of the disease is slow, but in some cases sarcoma develops in one of the affected bones. Treatment is of little avail.

Acromegaly.—A rare affection of the osseous system. It begins in young adults, and is characterized by enlargement of the hands and forearms, feet, jaws, and sometimes other bones. The spine is usually kyphotic, there is mental slowness or imbecility, and vision is impaired. The disease is due to over-secretion of the anterior part of the pituitary gland, in which an adenoma is frequently present. Removal of this has in many cases produced arrest of the disease or amelioration, and in others insertion of radon seeds has had a beneficial effect.

Hypertrophic Osteo-arthritis.—This is a condition of diffuse osteo-periostitis usually affecting the phalanges, metacarpals and metatarsals, and the long bones above the wrist and ankle. The fingers and toes are bulbous, the nails abnormally curved, with swelling above the wrist and ankle. The condition is found in long-standing toxic states—*e.g.*, chronic bronchitis, bronchiectasis, empyema, chronic jaundice, syphilis, and in influenza, but sometimes in apparently normal individuals. The cause must be treated.

Generalized Osteitis Fibrosa.—A disease associated with abnormal calcium and phosphorus metabolism and generalized cystic changes in bones; it is probably due to an excess of parathyroid secretion. In most cases an adenoma of parathyroid gland tissue is

present (see Fig. 6). It occurs usually in young and middle-aged adults, affecting both sexes, females more frequently than males. Severe disabling pain, localized swellings of the bones, or spontaneous fractures may be the first indication. Renal calculi are common and metastatic calcification may occur in the lungs, myo-

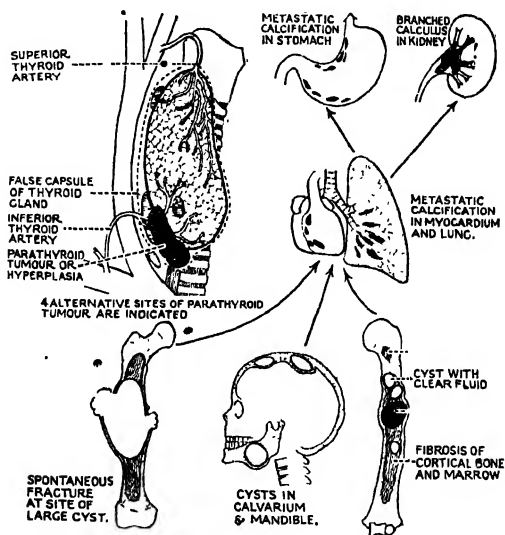


FIG. 6.—SCHEMA OF GENERALIZED OSTEITIS FIBROSA DUE TO PARATHYROID TUMOUR.

cardium, and other sites. The blood calcium is raised, excretion of calcium in the urine is above normal, blood phosphorus is lowered, and the plasma phosphatase raised.

Treatment. — Removal of the enlarged parathyroid results in improvement in practically all cases. Irradiated ergosterol should also be given.

Localized Cysts of Bone.

1. **Fibrocystic Disease.**—Solitary cysts in the shafts of the long bones, particularly the humerus and femur, occur in young people, and may result in fracture. Several bones may be affected.

2. **Hydatid Disease.**—Affects the pelvic girdle and the long bones, daughter cysts lying free in the medullary cavity. Thickening of the bone or spontaneous fracture may follow.

3. **Blood Cysts.**—Are found in cancellous tissue at the ends of the long bones, and probably result from the breaking down of a benign giant-cell tumour.

Tumours of Bone.

Varieties.—1. **INNOCENT:** (a) *Osteoma*, (b) *Chondroma*, (c) *Benign giant-cell tumour (osteoclastoma)*.

2. **MALIGNANT:** (a) *Osteogenic sarcoma*, (b) *Ewing's tumour*, (c) *Multiple myeloma*, (d) *Extraperiosteal fibro-sarcoma*, (e) *Secondary carcinoma*.

Osteoma and Chondroma.—These have already been described (see pp. 66, 63).

Benign Giant-Cell Tumour (Osteoclastoma).—A tumour causing local destruction of bone, rarely distant metastases, and thought to be derived from osteoclasts. It is found in the end of a long bone, especially the lower end of the radius or femur and the upper end of the tibia, or in the jaw, tarsus, or carpus, most cases occurring between the ages of sixteen and twenty-five years. Egg-shell crackling and spontaneous fracture are characteristic. Skiagrams show a bulky spherical shadow of cystic appearance replacing the bone, while beyond the tumour, cortex and periosteum are unaffected. No periosteal lifting is seen (see Fig. 7).

Treatment.—(1) Curettage, followed by swabbing with pure carbolic acid. (2) Resection limited to the affected area when conditions are unfavourable for curettage. Sometimes the resected tissue can be replaced by a graft—e.g., upper end of humerus by graft from fibula. (3) Amputation.

Osteogenic Sarcoma.—A sarcomatous growth derived from cells having the potentialities of osteoblasts, and so may contain spindle cells, giant cells, polyhedral cells, myxomatous, chondromatous or osseous tissue, and is rich in bloodvessels. Four anatomical types are recognized: (i.) Periosteal, (ii.) medullary and subperiosteal, (iii.) sclerosing, and (iv.) telangiectatic. Metastases are common, particularly in the lung, but other bones, the abdominal organs, brain, and skin may be involved.

These neoplasms arise most often in the second decade, in both sexes, and commence in the metaphysis of long bones. The lower limb is most commonly affected, the majority of the cases being in the region of the knee; 50 per cent. are in the femur, mainly at the lower end, but some in the shaft itself. The first symptom is severe pain of a boring or gnawing type, especially at night, and a limp may develop. Later, swelling appears, the skin is stretched and glossy, with dilated veins, while tenderness and pulsation may be felt. Spontaneous fracture may ensue or the neighbouring joint become involved, in which case a fusiform swelling arises resembling that of tuberculous arthritis.

Skiagrams may show a spindle-shaped tumour, with wedge-shaped osteophytes at each end fading into the mass (periosteal lipping), and absence of a definitely limited outline. Radiating spicules, thin laminae parallel to the shaft, or opaque areas may also be seen.

Treatment.—Results are very disappointing owing to early metastasis, the average survival period being twenty months. High amputation or disarticulation is usually followed by visceral recurrence. Irradiation is under trial, and X-rays appear to be superior to radium.

Ewing's Tumour.—Affects the shafts of the smaller long bones, the skull and occasionally other bones.

Pathology.—Microscopically, small polyhedral cells with round, oval, or elongated nuclei are seen, mucoid degeneration is common, and intercellular substance is conspicuously absent. The cells are frequently

arranged around bloodvessels. Metastases occur by both the lymph and blood streams, especially to the skull, lungs, and scalp, and lymph glands are not in-

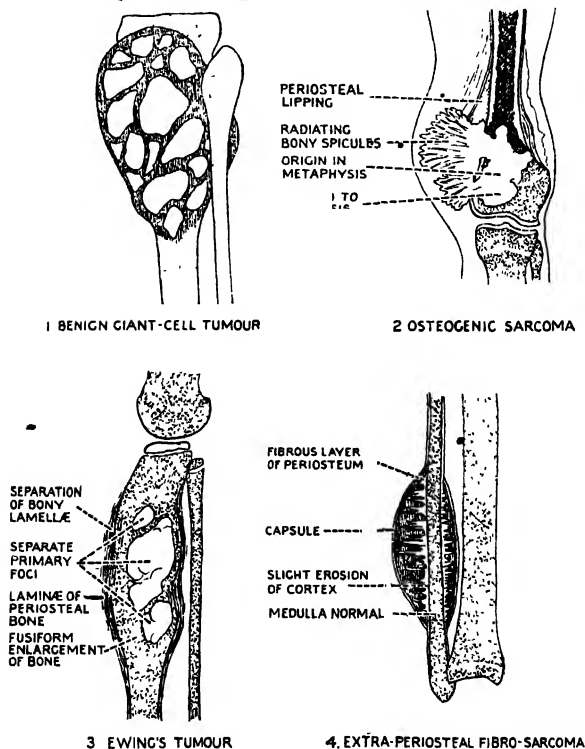


FIG. 7.—TUMOURS OF BONE.

frequently invaded. Ewing considers that the origin may be from perivascular lymphatic endothelium.

Signs and Symptoms.—Most cases are found between the ages of six and fifteen years, males being affected

three times as often as females. The disease may originate in the shaft of the long bones, the tibia, fibula, humerus, and ulna being more commonly affected than the femur; it may also commence in other bones such as the vertebræ, mandible, skull, etc. In many cases it appears to arise in more than one site simultaneously. Intermittent attacks of pain and fever occur with free intervals of several months; there is often a history of preceding trauma. Metastases, which may be delayed for years, eventually ensue.

Skiagrams reveal wide involvement of the shaft, which is displaced by growth and widened, with frayed longitudinal trabeculæ. There is no periosteal spindle and no lipping, such as are found in osteogenic sarcoma.

• *Treatment.*—Immobilization and irradiation, preferably by radium; if recurrence takes place, local excision or amputation should be carried out. The average duration of life in these cases is three years.

Multiple Myeloma.—This is a disease of the bone marrow. The bony thorax is most frequently involved—*i.e.*, sternum, ribs and vertebræ, all red marrow bones. The skull, pelvis and clavicle are next in order of frequency. Characteristic features are severe pain at the affected sites and marked secondary anæmia. Skiagrams show numerous rounded punched-out areas and pathological fractures are common. Bence-Jones albumosuria occurs in over half the cases. These tumours are radio-sensitive, but the effect is not lasting and most cases die within two years.

Extraperiosteal Fibro-Sarcoma.—Arises from the fibrous layer of the periosteum, remains encapsuled for a long time, and does not invade the bone; microscopically it is composed of spindle cells. The treatment lies in radical excision of the tumour, followed by prophylactic X-ray therapy.

Secondary Carcinoma.—Metastatic deposits in bone occur frequently. The primary tumour is usually situated in the genito-urinary tract, the breast, lung, thyroid or suprarenal gland. The bones most frequently affected are the ribs, vertebræ, sternum,

skull, pelvis, the femur and humerus. Pathological fracture is sometimes the first indication. As a rule the deposit is in the medullary cavity and is entirely *osteolytic*, skiagrams showing disappearance of bony structure. In the case of the prostate deposits are common in pelvis and spine and not infrequently *osteoplastic*, skiagrams showing marked sclerosis. X-ray therapy is very effective in relief of pain, and life may be prolonged several years.

CHAPTER XIV

DISEASES OF JOINTS

Acute Inflammation.

INFLAMMATION of joints is arbitrarily divided into *synovitis* when the synovial membrane is the part mainly affected, and *arthritis* when the capsule, articular ends and other structures are seriously involved.

Acute Synovitis may be traumatic, simple or suppurative.

1. **Acute Traumatic Synovitis.**—Results from injuries to the joint, which cause an effusion of blood and synovial fluid into the joint cavity. Clotting of blood may take place and is liable to be followed by organization into fibrous tissue, producing adhesions. Treatment consists of rest, pressure and cold applications, followed by graduated active exercises to maintain muscle tone. Elastic support to the joint must be continued for some weeks.

2. **Acute Simple Synovitis.**—Occurs in (i.) gonorrhœa, (ii.) syphilis, (iii.) gout, (iv.) rheumatism, and (v.) specific fevers. The effusion is usually clear, but may contain lymph, and is then turbid from the presence of leucocytes. Some cases tend to progress to suppuration, and the ligaments are liable to become infiltrated, softened and relaxed. Immobilization, hot applications, and aspiration, if distension is marked, are needed; if organisms are found in the

fluid, the joint should be washed out with normal saline or dilute eusol solution. Later, massage and elastic pressure are necessary.

3. **Acute Suppurative Synovitis.**—Cases of this type are very liable to develop into acute arthritis.

Causes.—(1) Penetrating wounds; (2) middle ear disease; (3) gonorrhœa; (4) pneumonia, typhoid and other specific fevers; (5) pyæmia; (6) extension from adjacent structures, especially bone.

Signs and Symptoms.—The joint is swollen, red, hot and tender, and held in the position of ease, usually slightly flexed. In some joints the effusion may be detected as a fluctuating swelling, distending and outlining the synovial cavity. Movement of the joint is very painful and there is a moderate degree of pyrexia.

• *Treatment*—1. *Early Cases.*—Repeated aspiration, followed by irrigation with normal saline, flavine (1 : 1,000) or Dakin's solution, and immobilization with slight weight extension. As soon as the effusion subsides, active graduated movements are started and gradually increased.

2. *Late Cases.*—Free drainage by multiple incisions left widely open, followed by irrigation daily with saline or flavine, with active movements from the beginning. On no account should drainage tubes be inserted into the joint, as they encourage ankylosis.

Acute Arthritis.—In this all the joint structures are involved. The ligaments become œdematous and softened, articular cartilages eroded and necrosed, the bone ends acutely inflamed and carious, and sequestra are sometimes formed. Bony spicules (osteophytes) may be produced by the inflamed periosteum.

Causes.—Are those of suppurative synovitis.

Signs and Symptoms.—Acute pain and high temperature are usual. The joint is swollen, the skin red, and the periarticular tissues œdematous. Later, pus may burst through the capsule, and thus reaches the surface or tracks along the muscles. A characteristic sign is starting-pains at night, indicating that the cartilages are affected. It is due to sudden movement as the patient is falling off to sleep, the protective muscles having relaxed. Softening of the

ligaments allows abnormal mobility and pathological dislocation; eventually the patient becomes exhausted from toxæmia or pyæmia.

Terminations.—(1) Recovery, with a movable joint, if treated early. (2) Bony or fibrous ankylosis. (3) Death from toxæmia, pyæmia, or chronic sup-puration leading to amyloid disease.

Treatment.—The following alternatives must be considered. (1) Immobilization in the position of ease, with gentle traction. (2) Repeated aspiration should be tried in the early stages. (3) Free incisions and irrigation. (4) When ankylosis is inevitable, continuous irrigation with Carrel-Dakin tubes in the joint is sometimes useful, the limb being kept in the best position for ankylosis. (5) Excision of the joint may be needed to promote free drainage, or to correct ankylosis in a faulty position. (6) Amputation is required if toxæmia or pyæmia threatens life.

Chronic Synovitis.—May follow an acute attack, or be chronic from the beginning. It may result from (i.) sprains, (ii.) excessive use, (iii.) thickened synovial fringes, (iv.) loose bodies, (v.) injuries to interarticular cartilages or ligaments, and (vi.) focal sepsis—*e.g.*, pyorrhœa. Two types are found: (1) *Serous*: In this there is marked effusion with swelling and weakness, but little or no pain. (2) *Papillary*: Effusion is slight, and the synovial fringes and villi are enlarged and thickened; they may be palpable and give rise to painful attacks, if nipped between the articular ends.

Treatment.—Rest, elastic pressure, radiant heat, diathermy and massage are all of value. Any cause should be dealt with. In stubborn cases, aspiration, with or without irrigation of the joint with normal saline or mild antiseptics, may be of value.

Hydrarthrosis.—By this is meant chronic distension of a joint with fluid other than blood or pus. It may be due to (i.) chronic synovitis, (ii.) osteo-arthritis, (iii.) Charcot's disease, (iv.) syphilitic synovitis, (v.) tuberculous synovitis (rare), and (vi.) gonococcal arthritis.

Baker's Cyst.—A hernial protrusion of the synovial

membrane through an attenuated site in the capsule. It is commonly due to osteo-arthritis or tuberculosis of the joint with effusion. The pouch, filled with synovia, may burrow for some distance among the muscles, and eventually loses its communication with the joint. If causing trouble, excision of the cyst is necessary.

Special Forms of Synovitis and Arthritis.

1. **Rheumatic Synovitis.**—Occurs in acute rheumatism (rheumatic fever), affecting several joints in turn and ending in resolution. Fever, acid sweats, liability to heart affections, and the rapid improvement with salicylate of soda—20 grains every four hours—distinguish it from other forms of arthritis.

2. **Rheumatoid Arthritis.**—A form of multiple arthritis, often symmetrical and affecting young adults of both sexes. It usually involves the joints of the hands and fingers in addition to others. The main feature is the extensive involvement of the capsular and other ligaments, and the tendency to severe deformity if this is not prevented by splinting. Pyrexia, tachycardia, extreme muscular atrophy and sweating, are also characteristic; other signs sometimes present are pigmentation of the skin, subcutaneous fibrous nodules, lymph gland enlargement, and anæmia. The disease runs a chronic course with acute exacerbations, and many cases eventually subside, leaving the patient practically crippled with fibrous or bony ankylosis of many joints. Focal sepsis appears to be responsible in a certain number of cases, and removal of diseased teeth or tonsils sometimes results in cure.

3. **Gouty Arthritis.**—Affects most often the joints of the hand and foot, especially those of the big toe. The onset is sudden, with great pain; the joint becomes swollen and the skin shiny and bluish-red. Deposits of urates (tophi) are often present around the joint and in the pinna; in time the joint becomes disorganized as in osteo-arthritis. In treatment colchicum or its alkaloids, alkaline purges and rest play important parts.

4. **Pyæmic Arthritis.**—Is often overlooked until the joint is disorganized and pathological dislocation has taken place. The reason for this is the absence of pain, partly accounted for by the toxic condition of the patient and also by the insidious onset.

5. **Typhoid Arthritis.**—In some cases a mere synovitis occurs, in others arthritis. *Bacterium typhosum*, alone or in conjunction with pyogenic organisms, is responsible; in the former case the lesion is either a mild polyarticular synovitis, or a copious monarticular effusion with pathological dislocation.

6. **Pneumococcal Arthritis.**—Occurs in adults, usually as a complication of pneumonia. In the majority of cases one joint is affected, but in a large minority two or more are involved. Suppurative arthritis with erosion of cartilage and destruction of ligaments is the rule, the pus being thick and creamy. In a few cases the effusion is clear and the condition confined to the synovial membrane. The upper limb is more often affected than the lower, but the knee is more frequently involved than any other joint.

In children, pneumococcal arthritis may be primary or secondary to otitis media or peritonitis of pneumococcal origin. The condition is subacute, with irregular fever and œdematous swelling of the joint, often without suppuration, but with a tendency to be followed by limitation of movement.

7. **Gonococcal Arthritis.**—Usually occurs during or just after an attack of gonorrhœa, but also in patients with gleet, sometimes following instrumentation. One or more joints, especially the knee, ankle or wrist, may be attacked, and the condition is sometimes bilateral. Three types are found: (i.) Synovitis. This may be acute, with pain and moderate effusion, or subacute, with little pain and considerable effusion. (ii.) Periarticular inflammation. The ligaments and tissues around the joint are infiltrated and softened, the muscles waste, and displacement follows. (iii.) Suppurative arthritis.

In all types ankylosis is to be feared, as the response to treatment is often disappointing.

Tuberculosis of Joints.

Tuberculous arthritis may arise either in the synovial membrane or in the articular end of one of the bones. In children and adolescents it more often commences in the epiphysis, but in adults either in bone or synovial membrane according to the joint involved. In addition to the usual predisposing causes, there is often a history of some slight injury to the joint preceding the onset.

Pathology.—In the synovial type the membrane is converted into tuberculous granulation tissue and caseation occurs. Gradually the process spreads over the articular cartilage, which is hollowed out and eroded, the underlying cancellous bone becoming carious or necrotic. Usually there is little fluid in the joint, but occasionally it is sufficient to cause distension (tuberculous hydrops), and contains numbers of loose (melon-seed) bodies composed of fibrin. In time the capsule, adjacent ligaments, muscles and tendons are invaded, becoming pulpy and gelatinous; tuberculous abscesses may form and burst, leaving sinuses leading into the joint.

When the disease originates in bone, spread to the joint cavity usually takes place by erosion of the articular cartilage, but in some joints—*e.g.*, hip—extension to the synovial membrane may occur without the cartilage being affected.

Signs and Symptoms.—The onset is insidious. After a slight injury, such as a twist or strain, there is complaint of pain and impairment of movement. On examination the joint is found in the position of ease, usually slightly flexed; wasting of the muscles is one of the earliest signs, and in superficial joints there may be an elastic, uniform, pulpy swelling without the usual signs of inflammation. On palpation the joint may be slightly hotter than that of the opposite side, while fluctuation and crepitus can sometimes be detected, especially in cases of tuberculous hydrops with melon-seed bodies. Movement is painful and limited in all directions, especially in cases commencing in bone.

Attacks of pain and increased swelling take place at intervals, and eventually, when the articular ends are eroded, starting-pains at night are a prominent feature. Later, abscesses develop and if allowed to burst secondary infection takes place; hectic fever, amyloid disease and death from exhaustion may follow.

Results.—(1) Complete cure with a movable joint if treated early. (2) Fibrous or bony ankylosis. (3) Death from toxic absorption and amyloid disease. (4) Generalized tuberculosis.

Diagnosis.—Skiagrams are of value, especially in differentiating between tuberculous disease of joints and neoplasms of bone. Examination of the effusion for lymphocytes and injection into a guinea-pig of the fluid withdrawn by aspiration may help in the distinction from other forms of chronic synovitis.

Prognosis.—Good if treated efficiently at an early stage. Bad in young children and old people, or when sepsis is superadded; also when tuberculous disease is present in other parts.

Treatment—General.—Fresh air, sunshine and good food play an important part. Many cases need sanatorium treatment.

Local.—1. Absolute rest by confinement to bed, and splints or plaster of Paris. Immobilization must be maintained for prolonged periods after all pain and tenderness have subsided.

2. Moderate extension. The object is to correct deformity and to minimize pain. The joint is gradually brought into the best position for ankylosis, should it occur.

3. Aspiration and irrigation of abscesses should be avoided for as long as possible (see p. 11).

4. Operations are only called for in neglected cases. (i.) Partial excision or arthrectomy aims at removal of all diseased tissue which is accessible. It is indicated in young children only, and even then is usually followed by recurrence of the disease or ankylosis. (ii.) Complete excision. Adjacent healthy tissue is cut through, and this, in children, involves injury to the epiphyses. It is of value when the

joint is disorganized, or where ankylosis is undesirable—*e.g.*, elbow and shoulder—and to correct deformity. (iii.) Amputation is needed when the patient is steadily losing ground in spite of treatment, particularly in old people, when sepsis is superadded or other foci of tuberculosis are present.

Special Joints—Shoulder.—This is an uncommon site. The primary focus is usually in the head of the humerus. Adults are those affected and the disease tends to be of a chronic type (*caries sicca*). Abscesses may point in front or behind at the edges of the deltoid. Excision of the head may be required and gives good results.

Elbow.—Often affected in young adults. The primary focus is in the synovial membrane, especially of the superior radio-ulnar joint. If immobilization at a right angle fails, arthrectomy in children or complete excision in adults is indicated.

Wrist.—The primary focus may be synovial or bony, or the disease may be secondary to involvement of the tendon sheaths. Prolonged immobilization should be tried; failing this, partial excision. In old people amputation is often necessary.

Sacro-iliac Joint.—Most cases occur in adults, commencing in the synovial membrane or bone, usually the sacrum. Pain and weakness of the back are complained of, worse after standing, walking or certain efforts, such as sneezing or coughing. Referred pain in the gluteal region or down the leg is due to the proximity of the lumbo-sacral cord. Puffy swelling of the joint may be seen and felt, tenderness elicited or fulness over the anterior aspect detected on rectal examination. Pain may be produced by compressing or separating the iliac crests. Apparent lengthening of the leg on the affected side is due to tilting down of the pelvis. Abscesses may point (i.) over the joint, (ii.) in the lumbar region, (iii.) in the iliac fossa, or track down into the pelvis and ischio-rectal fossa.

Diagnosis.—The condition must be differentiated from: (1) Sciatica. Pain and tenderness along the course of the great sciatic nerve usually distinguish this. (2) Hip disease. Compression of the pelvis is

painless and mobility limited at the hip-joint, together with apparent or real shortening. (3) Spinal disease. Rigidity and tenderness of the affected region are usually present. (4) Pelvic disease. Carcinoma of the uterus or rectum can be eliminated by careful pelvic examination.

Treatment.—General treatment (see pp. 41, 150) should be combined with prolonged rest in bed and immobilization by plaster or apparatus. Abscesses need aspiration, and operation is sometimes indicated; excision of as much diseased tissue as possible is to be aimed at. A jacket from pelvis to axilla should be worn subsequently for at least twelve months.

Hip.—Most common in children under ten years.

Pathology.—The primary focus may be synovial or bony, in the latter case originating either beneath the articular cartilage or in the under side of the neck distal to the epiphyseal cartilage. The great trochanter or the Y-shaped cartilage of the acetabulum may also be the site of origin (Fig. 8). If the disease begins in the bone, it extends to the synovial membrane and produces general infection of the joint. The muscles around the joint are permanently in spasm, and the head of the femur is pressed against the posterior and upper part of the acetabulum, causing absorption of the parts which are in contact. The acetabulum thus becomes enlarged, while the periosteum deposits new bone in advance, so that a rim is always present (travelling acetabulum). The head of the bone in the later stages is drawn up on to the dorsum ilii, and the limb is therefore much shortened.

Chronic abscess is very common, and usually points in front of or behind the great trochanter, or near the origin of the adductor longus tendon. Acetabular disease may extend inwards and produce an intrapelvic abscess.

Signs and Symptoms—Stage I.—The patient limps and complains of pain in the hip, inner side of the thigh or the knee. The muscles of the thigh and nates are found to be slightly wasted. The limb is apparently lengthened and flexed, everted and abducted.

The gluteal fold is lost owing to the flexion. Movement is painful and limited in all directions. The position of flexion, abduction and eversion is assumed because the ligaments are most relaxed in this position, and the capacity of the joint is greatest. The patient compensates for the abduction of the limb by tilting the pelvis downwards on the diseased side, so that the leg is apparently lengthened, but is brought parallel to the other; at the same time a lateral lumbar curvature of the spine is produced: he compensates for the flexion by tilting the pelvis forwards and downwards, thus producing lordosis. The true position of the limb is found by arranging the two anterior superior spines at the same level, and raising the limb until the lordosis disappears and the lumbar spine is flat. The limitation of movement is shown by the fact that the pelvis moves with the limb in attempts at flexion, rotation, abduction or adduction.

Stage II.—As the disease extends the limp increases, associated with starting-pains at night, fever and abscess formation. The flexion increases, and the limb now becomes adducted and inverted. The pelvis is then tilted upwards on the diseased side in order that the legs may be parallel, and apparent shortening is thus produced.

Stage III.—By this time softening of the posterior and upper ligaments and absorption of the posterior rim of the acetabulum result in real shortening. Flexion, adduction and inversion are even more marked than before. The supervention of secondary infection when abscesses burst results in hectic fever and eventually amyloid disease.

Diagnosis.—Careful examination will usually disclose wasting, deformity, and limitation of movement, even in the early stages. In coxa vara internal rotation and abduction are limited, but there is no wasting. In congenital dislocation all the movements are very free. In pseudo-coxalgia there is less pain, less limitation of movement, and less wasting; skiagrams may show flattening and broadening of the epiphysis with fragmentation, but no rarefaction or

caries, the bone being of normal density and the edges sharply defined.

Prognosis.—The ultimate death-rate is probably between 25 and 30 per cent., being higher in the poorer classes. Bony ankylosis occurs in a few cases, but in the majority treatment results in quiescence of the disease with a sound fibrous ankylosis in good position. If tuberculous disease develops elsewhere or sepsis supervenes the outlook is unfavourable.

Treatment—General.—This is of great importance in all cases, and residence in a sanatorium is highly desirable.

Local.—(1) Rest in bed with gradual extension and abduction by some form of apparatus such as a Robert Jones frame until pain and spasm are relieved. (2) Fixation in a plaster spica, bivalved to enable a watch to be kept for abscess formation. This must be continued until the disease is quiescent, probably about three years. (3) Aspiration of abscesses may be called for to prevent sinus formation. (4) Arthrodesis is indicated for patients in good general condition with unsound fibrous ankylosis and quiescent disease. (5) Excision of the head and neck of the femur may be a life-saving measure if the patient's general condition is deteriorating. (6) Chronic cases with increasing deformity or ankylosis in a faulty position should be treated by (a) subtrochanteric osteotomy, preceded if necessary by an extra-articular arthrodesis to correct an unsound fibrous ankylosis, or (b) Bankart's operation of complete resection of the hip-joint, including the tuberculous focus.

Knee.—The primary focus is synovial or bony in equal proportions, sequestra forming in half the cases of bony origin. In late stages there is often a *triple displacement* of the tibia, which is flexed, rotated outwards, and partially dislocated backwards. Gradual extension and prolonged immobilization are necessary. Most cases with bony foci need operation. Partial excision in children or complete excision in adults is the operation of choice.

Ankle.—The primary focus is usually bony. Abscess formation is frequent and the tendon sheaths

become involved. If fixation by plaster of Paris fails, removal of the astragalus and of diseased synovial membrane may be tried, but many cases need amputation.

Syphilis of Joints.

Acquired Syphilis—1. *Arthralgia*.—Vague pains in the joints, with no physical signs, may occur in the early secondary stage.

2. *Chronic Synovitis*.—(i.) Painful bilateral moderate effusion may be found in the early secondary stage. (ii.) Painless and more chronic symmetrical bilateral effusion, with rapid inexplicable variations in amount, may arise in the late secondary stage. Both varieties are prone to affect the knees.

3. *Gummatous Arthritis*.—Perisynovial gumma formation, which may be localized or diffuse, and affecting mainly the capsular and other ligaments; occurs in the tertiary stage; the gummata may break down and ulcerate, or cause thickening and contraction of the capsule.

4. *Chondro-arthritis*.—Also in the tertiary stage. The synovial membrane is thickened and the fringes enlarged; the cartilage cells proliferate, the matrix becomes fibrillated, softening and erosion follow, and the bone becomes pitted. There is no osteophytic formation.

Inherited Syphilis—1. *Epiphysitis*.—This may involve the neighbouring joint and is rarely followed by suppuration.

2. *Chronic Synovitis (Clutton's Joints)*.—Occurs most commonly in children (especially girls) from eight to fifteen years of age, and usually affects the knees. It is bilateral, painless, often sudden in onset, and the effusion large (hydrarthrosis).

3. *Gummatous Arthritis*.—As in acquired syphilis.

4. *Chondro-arthritis (Von Gies' Joints)*.—As in acquired syphilis.

In both acquired and inherited syphilis, Charcot's joints may develop in connexion with disease of the central nervous system.

Treatment.—Antisypilitic treatment, and elastic

pressure when effusion is present, should be tried. Some cases resist treatment, and excision may be required.

Osteo-arthritis.

A disease of one or more joints, in which degeneration, rather than inflammation, is a conspicuous feature.

Etiology.—(1). Trauma. A potent factor in many monarticular cases. (2) Occupation. Exposure to damp or cold often precipitates an acute exacerbation. (3) Age. It is particularly a disease of the elderly. (4) Focal sepsis. May be present in teeth, gums, tonsils, accessory sinuses, or alimentary tract.

Pathology.—The cartilage cells proliferate and burst into the joint, leaving the matrix, which has become fibrillated, looking like coarse velvet or plush. The softened cartilage is worn away at the points of pressure, and the underlying bone becomes hard and polished (eburnated). In spite of this hardness, the bone becomes worn away and often grooved. At the same time there is overgrowth of the cartilage at the margins (ecchondroses), which produces 'lipping,' while new bone is formed underneath (osteophytes). These may lead to impairment of mobility, or may be broken off and form loose bodies in the joint. The synovial membrane is thickened and its villi hypertrophied. Cartilage may also develop in the synovial fringes, and portions becoming detached form another type of loose body. Effusion may or may not be present.

Signs and Symptoms.—The disease is usually found in those of middle age or older, affecting the larger joints. In men the hips, in women near the menopause the knees are liable to be involved. Aching pain and stiffness, especially after rest, are the usual complaints. Swelling with effusion, marked crepitus, and deformity due to bony changes are all found. Skiagrams show distortion of joint surfaces, osteophytes, rounded translucent areas near the ends of the bones, and loss of the usual clear space, normally filled with cartilage, between the articular surfaces.

Heberden's nodes are periosteal bony growths frequently found near the terminal interphalangeal joints in cases with osteo-arthritis elsewhere.

Treatment.—The general health should be attended to and any foci of sepsis treated or removed. Residence in a dry climate and spa treatment are often of great value. Potassium iodide or iodine is sometimes of use. Locally, radiant heat, diathermy, massage and manipulation all help in some cases. Occasionally, in the monarticular variety when pain is a prominent feature, arthroplasty or alternatively the production of ankylosis by arthrodesis is justifiable.

Neuropathic Arthritis.

• A disease of joints associated with changes in the nervous system, central or peripheral (Charcot's disease).

Causes.—(1) Tabes dorsalis accounts for most cases. (2) Syringomyelia. (3) Myelitis. (4) Hemiplegia and paraplegia. (5) Peripheral neuritis.

Pathology.—Three types occur; they may be found together:

1. *Atrophic.*—The shoulder and hip are the usual sites. There is marked effusion. Atrophy commences in the bones, which become eburnated, intra-articular structures disappear, the capsule is thinned, and the synovial membrane, at first hypertrophied and villous, may be destroyed. Movement is excessive and dislocation frequent.

2. *Hypertrophic.*—This is most commonly seen in the knee. The bone ends are greatly enlarged in parts, atrophied in others; large calcareous or bony plaques and bosses appear in the capsule. The changes in the soft structures are similar to those in the atrophic variety. Fractures are not uncommon, and non-union is the rule.

3. *Osteo-arthritic.*—Can only be distinguished by the accompanying nervous disease from other cases of osteo-arthritis.

Signs and Symptoms.—The onset is either sudden or gradual. Painless swelling may follow a slight

injury in a patient who has not noticed any other symptoms. Firm œdema is often present around the joint, while hydrarthrosis, crepitus, abnormal mobility and deformity are obvious.

In tabes, lightning pains, ataxia, paræsthesiæ of the feet, dysuria, visceral crises, loss of knee-jerks and the Argyll-Robertson pupil may be present. In syringomyelia there may be muscular atrophy of the upper extremity, scoliosis, together with insensibility to pain and temperature changes, and trophic ulcers.

Treatment.—Apparatus to limit excessive movements may be needed.

Hæmophilic Disease of Joints.

In hæmophilia there is a liability to recurrent hæmorrhage into joints. The cartilage becomes worn, fibrillation of the matrix ensues, and at the periphery new cartilage is laid down (ecchondroses). The ligaments and synovial membrane become thickened, brown in colour, and adhesions may form. The joint is often painful, hot and tender. Rest, pressure and application of cold should later be followed by massage. Aspiration must be avoided at all costs.

Loose Bodies in Joints.

Four varieties are met with:

1. **Fibrinous.**—Consist of laminated fibrin, are rounded or flattened, and usually numerous. They are found in chronic synovitis and in tuberculous joints.

2. **Cartilaginous.**—These are either portions of articular or intra-articular cartilage, or abnormal formations of cartilage in diseased joints (ecchondroses).

3. **Bony.**—May result from necrosis or be separated by injury. Such loose bodies are usually covered by cartilage.

4. **Synovial.**—Thickened fringes may be nipped and detached. At times they are fibrous and fatty, in others the interior is cartilaginous.

Signs and Symptoms.—Are produced when the loose body is caught between the articular surfaces. Sudden severe pain occurs, the joint is temporarily locked

but quickly freed, and effusion follows. The patient can often by a particular movement get the loose body into a position in which it may be felt. The knee and elbow are the joints usually involved, especially the former.

Diagnosis.—Other forms of internal derangement may be difficult to distinguish unless the loose body can be felt, but the fact that locking is momentary is in favour of a loose body, while in the case of a torn semilunar cartilage there is usually a tender area to be found over the site of the injury. Also, there is no history of a primary twist or strain in the case of loose bodies.

Treatment.—The joint should be opened and the loose body removed. It is well, if possible, to fix it with the finger before opening the joint, as there is a great tendency for it to slip into some inaccessible situation.

Ankylosis.

By ankylosis is meant fixation or stiffness of a joint; if produced by extra-articular lesions it is termed false, if by intra-articular lesions true ankylosis.

False Ankylosis.—This may be fibrous and result from contraction of scar tissue in the skin, subcutaneous tissues, muscles and tendons, particularly after burns, severe lacerated wounds or suppuration; it may also follow congenital and paralytic deformities, or unreduced dislocations. The bony type is seen in myositis ossificans and in association with bone tumours arising near joints.

True Ankylosis—1. *Fibrous or Incomplete.*—This results from (i.) contraction of ligaments—*e.g.*, following gonococcal or rheumatoid arthritis; (ii.) adhesions within the synovial cavity resulting from chronic synovitis; and (iii.) union of eroded articular surfaces by fibrous tissue—*e.g.*, tuberculous arthritis.

2. *Bony or Complete.*—The articular surfaces are united by bone after erosion and destruction of the cartilage, as in suppurative arthritis. In osteo-arthritis or in Charcot's disease, interlocking osteophytes may produce a similar result.

Treatment.—This depends to a large extent upon the cause. In fibrous ankylosis with few adhesions, massage movements and radiant heat should first be tried; later, manipulation under an anæsthetic, *except in tuberculous cases*, followed by exercises and massage. **Arthroplasty** is of great value in some cases with dense adhesions or bony ankylosis, but should never be employed in tuberculous cases. The joint is freely exposed, and the articular ends separated; a fascial flap, pedicled or free, is then interposed and stitched in position. Movements are commenced after seven to ten days. In the shoulder and elbow excision of the joint is often of value, while in certain cases affecting the hip osteotomy of the femur (subtrochanteric) is the operation of choice.

CHAPTER XV

DEFORMITIES

THE term 'deformity' includes conditions due to many different causes, and, since in most cases the correct treatment depends on the cause, it is of use to formulate the following classification:

(a) **Congenital.**—These are present at birth and may be hereditary. Some are said to be due to trauma or disease of the mother during pregnancy, others to errors of development leading to supernumerary, deficient or absent parts. The foetus may take up abnormal positions *in utero* possibly as the result of deficient liquor amnii or amniotic bands and adhesions. Certain diseases may affect the skeleton before birth (*e.g.*, achondroplasia), others the nervous system (*e.g.*, spastic palsies). Birth injuries account for another group of cases. In many instances several congenital anomalies are present concurrently.

(b) **Acquired.**—These make up by far the majority of deformities, and their causes may be tabulated as follows:

(1) *Affections of Bone.*—Disturbances of growth or

disease may be responsible for some, while injury accounts for many—*e.g.*, malunited fractures.

(2) *Affections of Muscles, Fasciæ, Ligaments and Skin.*—Injury may be followed by cicatrization from wounds or burns. Acute inflammation may lead to softening and stretching of fasciæ and ligaments—*e.g.*, gonococcal pes planus. Muscle weakness or spasm may cause postural changes—*e.g.*, adolescent scoliosis.

(3) *Nervous Diseases.*—Spastic or flaccid paralysis may be responsible for deformity.

(4) *Compensatory.*—Many cases develop to compensate for other deformities—*e.g.*, scoliosis secondary to congenital dislocation of the hip or torticollis.

Torticollis, or Wry-Neck.—A deformity due to contracture or spasm of the sterno-mastoid, though the trapezius, deep cervical rotators, and the cervical fascia may be involved in some cases. The head inclines to the affected side, the face is turned towards the sound side.

Varieties—1. *Congenital.*—This is thought to be due to laceration of the sterno-mastoid followed by fibrous repair, to obliteration of the sterno-mastoid branch of the superior thyroid artery, or to acute venous obstruction during labour leading to intra-vascular clotting. In the first few months of life an elongated swelling appears in the lower half of the sterno-mastoid, the so-called 'sterno-mastoid tumour.' Contracture of the deep fascia and posterior cervical muscles is found later and scoliosis develops. The face gradually becomes asymmetrical, being smaller on the affected side.

Treatment.—Massage, manipulation and apparatus may succeed in early mild cases. In others, subcutaneous tenotomy of the sterno-mastoid followed by forcible stretching may suffice, but open division of the sterno-mastoid, contracted deep fascia and other muscles is sometimes necessary.

Active and passive movements should be practised for about six months to prevent recurrence.

2. *Rheumatic.*—Is of sudden onset, following exposure to cold or draught, and the muscles are tender. Aspirin is needed for the pain, and locally

deep massage or lin. methyl salicylate soon effects a cure. Short-wave diathermy is of value in relieving pain.

3. *Cicatricial*.—May follow severe burns, suppuration, or injuries which result in scarring of skin or muscles.

4. *Reflex*.—Spasm of the muscles, to prevent movement and pain, occurs in such conditions as acute adenitis, cellulitis, and tuberculous cervical caries.

5. *Spasmodic*.—Usually occurs in adults of a neurasthenic type, but the condition may have an organic basis, such as a lesion of the mid-brain or irritation of the cervical nerve roots at the intervertebral foramina due to arthritis. Twitchings of the neck are present, sometimes with other movements. If general treatment fails, which is often the case, resection of the spinal part of the spinal accessory nerve on one side and of the posterior primary divisions of the first three cervical nerves on the other must be performed.

6. *Syphilitic*.—Follows a gumma of the sternomastoid unless treatment is started early.

7. *Hysterical*.—Usually found in women, and needs psychological treatment.

8. *Secondary*.—May follow infantile paralysis of the opposite side, and should be prevented by exercises and retentive apparatus.

Cervical Rib.—Is due to an abnormal growth of the anterior tubercle of the seventh, or rarely the sixth, cervical vertebra. All degrees occur, from a mere rib stump with a fibrous cord up to a complete rib articulating with the first rib near the scalene tubercle. By its growth it may encroach on the subclavian artery and the lower and inner cords of the brachial plexus. Though often bilateral, it may be symptomless, or the symptoms may be confined to one side only, frequently corresponding to the smaller rib.

Signs and Symptoms.—These may occur at any age, usually between thirty and forty. There is neuralgia along the inner side of the arm and forearm, and

weakness of the hand, followed by wasting of the thenar eminence or interossei.* Vasomotor symptoms such as coldness and blueness of the hand and trophic changes in the fingers may be present. The radial pulse may be diminished and the subclavian artery prominent, especially when the arm is hanging down. The vasomotor symptoms are probably due to pressure of the rib on the sympathetic nerves around the brachial plexus. X-rays reveal only the ossified portion of the rib.

Treatment.—Excision of the rib and, if possible, its periosteum, together with the fibrous cord if present, is generally performed. Recently it has been shown that division of the scalenus anticus muscle may be adequate.

• **Scalenus Anticus Syndrome.**—In this condition the nervous and vascular symptoms associated with cervical rib occur in the absence of any demonstrable bony abnormality and appear to be due to pressure on the subclavian artery and brachial plexus by the scalenus anticus and first rib. The treatment is division of the lower end of the scalenus anticus muscle.

THE SPINE

Scoliosis.—This is a lateral curvature of the spine accompanied by rotation of the vertebræ. The condition leads to alterations in the relative positions of the ribs and pelvis, and changes in muscles and ligaments which may bring about compression or displacement of the lungs or abdominal organs.

• **Classification**—I. *Postural or Functional.*—This type, which occurs in children of school age, can be corrected voluntarily. It has been attributed to the habitual assumption of a faulty posture, but in many cases no cause can be found. The curve is generally single and convex to the left. The left shoulder is elevated and the right shoulder girdle is thrown backwards, the left forwards. The right side of the back is unduly prominent when the patient bends forwards and the hollow of the waist line is exaggerated on the right side. Further evidence of weak

musculature such as round shoulders or flat feet is frequently found. If untreated, this type of scoliosis becomes permanent.

2. *Structural or Fixed*.—In this type the patient is unable to correct the deformity voluntarily, as it is accompanied by structural alterations in the vertebræ, ribs, ligaments and muscles, and is therefore permanent. All variations from a gentle convexity to a sharp angulation known as 'razor-back' are found, and there are compensatory curves in the opposite direction above and below the principal curve. The most characteristic feature is the backward projection of the ribs or lumbar transverse processes in the affected region.

Ætiology.—In the majority of cases no definite cause can be found, but the factors concerned may usefully be classified as follows:

(a) *Congenital*.—This is due to congenital malformation of the spine, scapula or thorax, to deforming intra-uterine pressure, or to antenatal paralysis.

(b) *Acquired*.—1. *Compensatory*.—The curvature develops to compensate for other deformities—e.g., congenital dislocation of the hip, torticollis.

2. *Secondary*.—This results from disease of the spine or thorax such as caries, rickets, empyema, or fibroid lung.

3. *Paralytic*.—Infantile paralysis is the most important nervous disease responsible.

4. *Occupational*.—The assumption of faulty attitudes by children is the commonest cause of this type.

Pathology.—The vertebræ at the apex of the curve are compressed to a wedge shape, the thinnest part of the wedge being on the side of the concavity. At the points of maximum curvature the intervertebral discs are compressed. On the side of the concavity the ligaments are thick and the muscles hypertrophied; on the side of the convexity the ligaments thin and the muscles atrophied.

Symptoms.—Unless there is some coexisting disease, advice is usually not sought until the deformity is well established and a high shoulder, high

hip or prominent shoulder blade is noticed. Older children may complain of backache, and in severe cases acute pain may be caused by pressure of the lower ribs against the iliac crests. Gastro-intestinal or respiratory symptoms may be complained of.

Prognosis.—If properly treated, postural scoliosis can be permanently cured. Mild degrees of structural scoliosis can also be cured in young children, but in severe cases, especially in older children, the best result that can be hoped for is a lessening of the deformity.

Treatment—1. *Postural Scoliosis*.—Any cause contributing to faulty posture such as badly designed school furniture, reading in awkward attitudes, and defects of sight must be corrected. The general health must be treated by fresh air, good food and tonics. Graduated exercises of the spinal muscles should be prescribed, and it may be advisable to fit a light temporary corset between the exercises.

2. *Structural Scoliosis*.—Exercises may be of use in the mildest types, but should not be continued unless improvement results.

(a) *Correction* is best obtained by some form of plaster jacket—e.g., a split turnbuckle jacket—or by head suspension from a Fisher frame.

(b) *Fixation* is maintained by a spinal support or by operative spinal fusion, when the maximal correction has been achieved.

Congenital scoliosis and scoliosis secondary to empyema are, of course, incurable.

Kyphosis.—Abnormal backward curvature of the spine, usually affecting the dorsal region.

Varieties — 1. *Adolescent*. — Usually occurs at puberty, and is due to weakness of the spinal muscles and habitual stooping. Some cases are due to organic disease, especially rickets, vertebral epiphysitis, and prolapsed nucleus pulposus.

2. *Occupational*.—Porters and cobblers often exhibit this deformity.

3. *Senile*.—The vertebral bodies become rather wedge-shaped, there is necrosis of the anterior parts of the intervertebral discs, and osteoporosis of the whole spine.

4. *Paralytic*.—May occur in such diseases as tabes and poliomyelitis.

5. *Angular*.—Due to localized injury or disease of the spinal column—*e.g.*, fractures, caries, neoplasms, Kümmell's disease.

6. *General*.—This type occurs in diseases such as spondylitis deformans, osteitis deformans, osteomalacia and acromegaly.

Treatment.—When the deformity can be actively or passively reduced, the main indications are correction of faulty posture, exercises and measures directed to improving the general health. If an organic cause can be found in children or young adults; it must be treated by recumbency for a period of months followed by a plaster jacket. Kyphosis in old people is seldom amenable to treatment, though a spinal brace may sometimes relieve pain.

Lordosis.—An abnormal forward curvature of the lumbar region, nearly always secondary to other deformities. Common causes are kyphosis due to spinal caries, congenital dislocation of the hip, and hip disease. It also results from pregnancy or large abdominal tumours, and from a pendulous abdomen in fat people. In certain diseases such as rickets and infantile paralysis the condition is not compensatory. Treatment should be directed towards removal of the cause.

Spondylolisthesis.—A condition in which there is a forward displacement of the body of the fifth lumbar vertebra, less frequently of the fourth, usually causing symptoms between thirty and fifty years. The primary defect in most cases is a congenital failure of bony fusion between the vertebral body and neural arch, which allows subluxation to occur if the ligaments are stretched. Trauma caused by lifting heavy weights or falling on the buttocks may be an added factor. The condition often occurs during pregnancy. Backache is the commonest symptom, and clinical examination may show a lumbar lordosis, a marked hollow over the top of the sacrum, and an exaggeration of the normal mid-line groove. A lateral X-ray of the lumbar region is conclusive. Treatment

depends upon the stage of the disease. In early cases an effort should be made to reduce the displacement by manipulation or by suspension of the body weight from the legs. After reduction, fixation in a plaster-of-Paris jacket or a reinforced corset will prevent subsequent lumbo-sacral strain. In chronic cases lumbo-sacral fusion by Hibb's or Albee's operation or by fusion of the vertebral bodies is called for.

THE UPPER EXTREMITY

Sprengel's Shoulder (Congenital Elevation of the Scapula).—A condition in which one scapula, sometimes smaller in size than the other, and rotated so that its lower angle is nearer the mid-line, is also situated higher than normal. The serratus magnus and lower third of the trapezius are often defective, and the whole limb on that side may be smaller. A fibrous, cartilaginous, or bony union may be found between the spine and the scapula. Benefit may follow the division of this band. As a rule the deformity causes little disability and needs no treatment.

Cubitus Valgus.—The forearm is abducted to an abnormal degree at the elbow joint, while in *cubitus varus* the angulation is inwards. Both these deformities may be congenital, but usually follow badly united fractures of the lower end of the humerus. Delayed ulnar palsy may follow cubitus valgus, and is treated by anterior transposition of the ulnar nerve. A supracondylar osteotomy may be required to correct the deformity in either condition.

Volkmann's Ischæmic Contracture.—A rare condition which is usually seen after supracondylar fracture of the humerus or fracture of radius and ulna, but may occur apart from fractures and sometimes follows arterial embolism. The early signs or symptoms usually appear a few hours after the injury, but may be delayed for several days. Burning pain may be felt in the hand or forearm, but the *onset may be quite painless*. Pallor of the hand or cyanosis and swelling of the fingers are associated with an absent

or weak radial pulse. Within two days of onset the condition will be established. The wrist is bent, the fingers extended at the metacarpo-phalangeal joints, but flexed at the interphalangeal joints, and the forearm may be pronated and the elbow flexed. In at least 50 per cent. of cases there is an injury to one or more of the main nerves.

It would appear that the condition is due to contusion or laceration of the brachial artery and concurrent spasm of the collateral circulation, but some authorities still maintain that venous occlusion is responsible.

Treatment.—*Prevention is better than cure*, and acute flexion of the elbow, tight bandages or splints should be avoided. In early cases the brachial, radial and ulnar arteries should be exposed by division of the deep fascia of the antecubital space, and the hæmatoma evacuated. It has recently been suggested that if intravenous injection of papaverine fails to relieve spasm, the bruised section of artery should be removed. Once contracture is established, gradual stretching and splinting is effective in slight cases, but operation is needed for severe cases. Separation of the common flexor origin followed by stretching of the hand and fingers is the usual procedure, but the outlook is poor.

Madelung's Deformity.—Subluxation of the wrist, originally described as congenital, but probably due to occupational strain or severe trauma. The underlying cause is an injury to the attachment of the fibro-cartilaginous disc of the radio-ulnar joint, which allows forward dislocation of the radius and carpus, leaving the lower end of the ulna prominent on the back of the wrist. Dorsiflexion of the hand is limited, and the wrist appears enlarged and is insecure. Recent cases should be treated by reduction of the deformity and a plaster cast. In long-standing cases the triangular cartilage should be stitched into place and the forearm put into plaster. If curvature of the radius is present, osteotomy of its lower end is required.

Dupuytren's Contracture.—This affects the middle

division of the palmar fascia, and is met with in middle-aged people, especially skilled craftsmen, workmen and mechanics. It is often hereditary and familial and may be bilateral. Trauma is the most important ætiological agent, but general factors such as gout or a toxic focus may play a part in the causation. The induration of the fascia begins at the base of the ring finger and spreads towards the ring and little fingers and up the palm, gradually involving the skin. The metacarpo-phalangeal and proximal interphalangeal joints become flexed into the palm and the terminal phalanx remains extended. The condition must be diagnosed from congenital contracture of the fingers (see p. 170) and from contraction of the flexor tendons, in which attempting to straighten the fingers produces tension in the tendons above the wrist.

Treatment.—Subcutaneous division of the bands by a tenotome, with subsequent fixation in the straight position, is unsatisfactory in that relapse soon occurs. Excision of the whole of the affected fascia and skin, grafting any uncovered area when the skin cannot be united, gives better results, but permanent cure cannot be guaranteed. Excision of the base of the first phalanx is necessary in severe cases.

Mallet Finger.—Avulsion of the extensor tendon from its insertion into the terminal phalanx may occur with or without a chip fracture of the base of the phalanx. It is usually due to strong flexion of the finger while the tendon is actively contracting, such as is caused by a blow on the top of the finger at cricket or baseball, and may also result from a blow on the tendon insertion. The terminal phalanx cannot be actively extended and the proximal interphalangeal joint may be hyperextended.

Treatment consists in immobilization of the finger in plaster with the terminal interphalangeal joint hyperextended and the proximal joint in flexion for about six weeks. Operative suture of the tendon into its insertion may be necessary if there is no fracture and tags of tendon project into the joint, or in cases which are not seen until several weeks have elapsed since the injury.

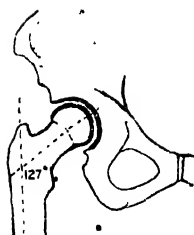
Trigger Finger or Snap Finger.—A condition in which one or more fingers remain flexed when the patient opens his hand, and when he extends the affected digit with the other hand the movement is completed with a jerk. It is due to a stenosing tendovaginitis of the flexor tendon at the level of the metacarpo-phalangeal joint, and a tender nodule can be palpated. If rest in a splint for a few weeks is ineffective, the thickened part of the tendon sheath should be excised.

Congenital Abnormalities.—*Contracture of the fingers* is usually limited to the little finger, and affects only the proximal interphalangeal joint. *Club-hand* is generally due to congenital absence of the radius. The hand is pushed over to the radial side, and the lower end of the ulna is expanded to articulate with the carpus. *Polydactylism* consists in the presence of supernumerary fingers or toes, which may be removed if they give trouble or are unsightly. *Macrodactyly* is due to congenital overgrowth of a finger or toe and may necessitate amputation. *Syndactylism or webbed fingers or toes* may need a plastic operation in the hand, but not in the foot.

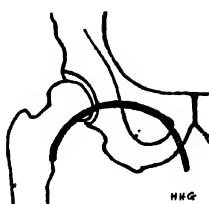
LOWER EXTREMITY

Congenital Dislocation of the Hip.—This is the commonest and most important of congenital dislocations. It is often hereditary and may be unilateral or bilateral. The majority of cases are in girls. The most likely cause is a primary osseous defect in the acetabulum, but some cases may be due to an intra-uterine muscular dystrophy. The actual dislocation may occur before birth, when the legs are first extended, or when the child begins to walk.

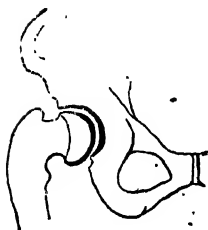
Pathology.—The acetabulum is shallow and its postero-superior part deficient, the head of the femur becomes atrophied and flattened, the neck of the femur shortened, and the pelvis small and tilted forwards on the side of the dislocation. The capsule is stretched and becomes hour-glass shaped, the muscles running from the pelvis to the shaft of the femur are shortened,



(a) Normal.



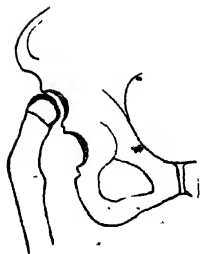
(b) Shenton's line.



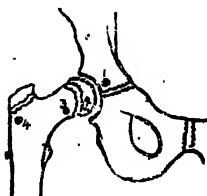
(c) Coxa vara.



(d) Coxa plana (pseudo-coxalgia).



(e) Congenital dislocation.



(f) Sites of tuberculous of hip in order of frequency (1, 2, 3, 4).

FIG. 8.—ILLUSTRATING VARIOUS CONDITIONS OF THE HIP.

while the obturators, quadratus femoris and psoas are stretched and elongated.

Signs and Symptoms.—The condition is usually not noticed until the child begins to walk, but may be suspected at birth if the perineum is unusually broad or if there is a swelling in the gluteal region. Walking is painless, but the child limps in unilateral cases and has a waddling gait if the dislocation is bilateral. Lordosis is always present. On palpation the pulsation of the femoral vessels is difficult to feel on the affected side. In unilateral cases there is asymmetry of the groove between the labia and the thigh, the affected leg is shortened and Trendelenburg's sign positive. The condition must be diagnosed from coxa vara and from pathological dislocation due to joint disease or poliomyelitis. X-ray examination is conclusive.

Treatment — 1. *Early Cases.* — Up to the age of twelve months Putti's abduction treatment should be tried. The limbs are abducted to the maximum and internally rotated, and maintained in this position by an adjustable splint which allows progressive abduction. The apparatus can be removed for cleaning the child and for gentle manipulative exercises twice daily. Treatment must be continued until clinical and X-ray examination show reduction to be perfect, usually about eight to twelve months. This method is applicable to unilateral and bilateral cases.

2. *Eighteen Months to Two Years (Lorenz's Method).* —The dislocation is slowly reduced with as little violence as possible under deep anæsthesia. A plaster-of-Paris spica including both legs is applied from the nipple line to below the knees with the hips fully abducted and the knees flexed to a right angle. After reduction the case is watched by repeated X-ray examinations and the plaster changed every three months. In favourable cases walking may be allowed after nine months with a short plaster spica.

3. *After Two Years.* —If manipulation fails, open reduction should be undertaken. A Smith-Petersen incision is employed, the capsule opened and the narrow part divided. The head of the femur is

replaced, the capsule closed and the muscles carefully sutured. The limb is put up in plaster-of-Paris in full abduction with flexion of the knee and hip to a right angle. Some authorities combine this operation with a reconstruction of the acetabulum by a tibial bone graft or osteoperiosteal flap from the ilium, others consider that reconstruction is indicated only in those cases in which redislocation is probable—*e.g.*, after six years of age.

4. *Old Unreduced Cases.*—After twenty years unilateral cases are best treated by a Lorenz bifurcation osteotomy or by osteotomy of the femur below the trochanters, followed by abduction of the lower fragment (Schanz). Bilateral cases should be treated by a shelf reconstruction operation or a bifurcation osteotomy on both sides.

Coxa Vara.—A deformity of the hip due to changes in the upper end of the femur. The angle between neck and shaft is diminished, the neck is shortened and the trochanter displaced upwards. The shaft of the femur is everted. Softening of the bone is followed later by sclerosis.

Classification.—(a) *Congenital.*—This may be primary or associated with some intra-uterine disease of bone such as achondroplasia.

(b) *Acquired.*—The primary lesion may be in the head of the femur, the epiphysis, the neck or the trochanteric region. Individual lesions should therefore be described as *capital*, *epiphyseal*, *cervical* or *trochanteric*. The causes may be grouped as follows:

(1) Perthes' disease of the head of the femur is described on p. 132.

(2) Destructive arthritis due to pyæmia, tuberculosis, osteomyelitis, etc., may affect the head, the neck or the trochanters (see p. 145).

(3) Malunited fractures may cause cervical or trochanteric coxa vara.

(4) Constitutional disease such as rickets may produce cervical coxa vara.

(5) Trauma is the main factor in adolescent coxa vara.

Adolescent Coxa Vara.—This is always of the

Bow Legs is the term applied to bilateral genu varum combined with forward curvature of the legs. It occurs in rickety children who have been allowed to run about during the acute stage. There is usually inward rotation of the lower end of the tibia, which leads to turning-in of the toes and separation of the knees when the child stands with the feet together. In the early stages treatment of the rickets should be combined with manipulation of the legs several times a day. If this is ineffective, a steel brace may be used. Manual osteoclasis or osteotomy of the tibiae may be needed in addition. It is important to distinguish between rachitic bow leg and the sabre-blade tibia of syphilis, in which the curve is purely antero-posterior, affects the middle third of the tibia, and has a rounded anterior edge.

Genu Recurvatum.—Hyperextension of the knee, which may be congenital or result from disease or injuries of the joint. Operative division or lengthening of the quadriceps and its lateral expansion, or fusion of the patella to the tibia may be needed.

Talipes is a deformity in which the foot is inclined at an angle to the leg, so that the sole no longer rests on the ground in the normal position when the patient bears weight on it.

Varieties—1. *Talipes Equinus*.—The heel is drawn up and the patient walks on the heads of the metatarsal bones.

2. *Talipes Calcaneus*.—The front part of the foot is drawn up and the patient walks on the heel.

3. *Talipes Varus*.—The foot is inverted and the patient walks on the outer border.

4. *Talipes Valgus*.—The foot is everted and the patient walks on the inner border.

5. *Compound Deformities*.—Equino-varus and calcaneo-valgus are more common than equino-valgus and calcaneo-varus.

Talipes equino-varus is by far the most common variety.

The deformity may be either congenital or acquired.

Congenital Talipes is often hereditary and bilateral, and occasionally occurs with other congenital

abnormalities. The most probable cause is increased intra-uterine pressure on the foot due to deficient amniotic fluid; there is lack of development or mal-development of the bones, ligaments and muscles of the foot.

Acquired Talipes may be due to (1) paralysis following poliomyelitis, peripheral neuritis, and nerve injuries; (2) central nervous disease producing a spastic condition—*e.g.*, spastic paralysis; (3) cicatricial contraction after injuries or deep suppuration; (4) compensatory to a short leg; (5) prolonged maintenance of a faulty position from pressure of bedclothes on the foot (*talipes decubitus*); (6) irregular growth of one of the leg bones due to disease of an epiphysis—*e.g.*, osteomyelitis.

POINTS OF DISTINCTION BETWEEN CONGENITAL AND PARALYTIC TALIPES EQUINO-VARUS.

	<i>Congenital.</i>	<i>Paralytic.</i>
History	Affection has existed from birth	Not developed till second or third year.
Feet affected ...	Bilateral	Generally unilateral.
Circulation ...	Good	Limbs cold and blue.
Muscles ...	Little wasting	Marked wasting.
Electrical reactions ...	Not much impaired	Absent in paralyzed muscles.
Growth of bones	May be impaired	Impaired.
Skin ...	Sole creases obvious	Sole creases absent.

Talipes Equino-varus (Club-Foot).—The commonest form of congenital talipes. It also may be acquired and due to infantile paralysis of the extensor and peroneal muscles. *Three degrees* of congenital deformity are recognized. In the *first* the fore-foot is adducted; in the *second* inversion and equinus are also present; while in the *third* degree there is inversion and adduction of the fore-foot, but no equinus

element in the deformity, so that the toes point upwards and the sole is in contact with the medial surface of the tibia. There is a great increase in the obliquity of the neck of the astragalus, so that the scaphoid and anterior part of the foot are carried inwards and the dorsal tendons with them. The upper surface of the astragalus projects forwards on the dorsum of the foot, and only its posterior part comes into contact with the tibia and fibula. The shape of the other tarsal bones is secondarily altered and the ligaments on the inner side of the foot are shortened. In unilateral cases the leg is less well developed than on the healthy side. The inner border of the foot is shortened and concave, the lateral border convex. Many cases have a marked genu valgum and the patient has a stumbling gait. Bursæ and callosities may form over the weight-bearing areas.

Treatment.—The deformity must be corrected and the muscles developed sufficiently to maintain the correction. The patient must be supervised until growth is completed, as there is a tendency to retrogression.

1. *Early Cases.*—Treatment should be instituted as soon as possible—*i.e.*, seven to ten days after birth. Up to the age of two manipulation can be effected manually, but after this age the foot needs to be placed in a modified woodworker's vice and the deformity reduced with an instrument like a pair of nutcrackers. Fixation is then maintained with a Browne's splint, which ensures that the feet shall be connected horizontally at any desired angle to the sagittal plane of the body. If the equinus element is not completely overcome by this method, it may be necessary to obtain forcible correction with a vice and to encase the leg in plaster from the toes to the mid-thigh in an over-corrected position for a few days before the splint is used. The splint must be removed for manipulation once a fortnight, and the treatment continued for about nine months. The splint is then replaced by a specially constructed pair of boots which hold the feet in the same position as

the splint, and must be worn until there is no adduction or inversion deformity and the child is able to evert and dorsiflex the foot to about 90 degrees.

2. *Older Children*.—Manipulation must be carried out under general anæsthesia and a plaster applied from the toes to the mid-thigh. In some cases tenotomy of the plantar fascia and muscles and elongation of the tendo Achillis may be required. A Browne's splint is worn to maintain correction and physiotherapy instituted.

3. *Relapsed Cases*.—Open operation is indicated, with detachment of sufficient of the muscles, fasciæ and ligaments to allow manipulation of the foot.

4. *Adult Cases*.—As much improvement as possible should be obtained by manipulation and operation on the soft tissues. In most cases a cuneiform tarsectomy or an arthrodesis of the mid-tarsal and subastragaloid joints will also be needed.

Talipes Equinus.—This variety usually occurs as the result of spastic paralysis of the calf muscles or of paralysis of the dorsiflexors due to poliomyelitis. It may follow cicatricial contraction or be secondary to shortening in hip disease. One form is known as talipes decubitus. It varies in degree from inability to flex the ankle beyond a right angle to a stage when walking occurs on the metatarsal heads. In severe cases there is a pes cavus deformity, and callosities and bursæ develop over pressure points.

Treatment.—The primary cause should be treated whenever possible. In mild cases elongation of the tendo Achillis or transplantation of the peronei and tibialis posticus into the dorsum of the tarsus is sufficient. For severe cases operations involving subastragaloid arthrodesis and reconstruction of the foot are performed.

Talipes Calcaneus may be congenital or acquired. It is a rare deformity, and generally combined with a valgus or varus element. Acquired cases are due to infantile paralysis or overstretching of the tendo Achillis following tenotomy.

Treatment.—Transplantation of the peroneus longus or tibialis anticus into the tendo Achillis may be

adequate, but in most cases a stabilizing operation such as a subastragaloid arthrodesis is needed.

Talipes Valgus.—This is very similar to an advanced degree of flat-foot. It is generally seen as a calcaneo-valgus deformity resulting from spasm of the peroneal muscles or poliomyelitis affecting the calf muscles.

Treatment.—One of the peroneal tendons may be inserted subperiosteally into the medial surface of the scaphoid, but an astragalo-scaphoid arthrodesis will probably be needed in addition:

Pes Planus or Flat-Foot.—A deformity of the foot with loss of the normal arches. The anterior part is nearly always abducted and everted.

Varieties.—It is useful to divide flat-foot into five stages, although there is no sharp line of distinction between the various types.

1. *Incipient Flat-Foot.*—Excessive pressure is being exerted on the muscles and ligaments of the sole and inner side of the foot. There is no evident deformity, but marked pain and tenderness.

2. *Voluntary Flat-Foot.*—The muscles and ligaments supporting the arch have lost their postural tone, so that the arch is flattened, but the deformity can be voluntarily reduced.

3. *Resistant Flat-Foot.*—This type can be corrected only by passive movement, as secondary adaptive changes have taken place. The head of the astragalus is depressed and the os calcis displaced medially, with its anterior end depressed, so that the head of the astragalus, the sustentaculum tali, and the scaphoid tuberosity are prominent. The tendo Achillis appears to be deviated to the lateral side, the tibial tendons are lengthened and the peronei shortened.

4. *Rigid Flat-Foot.*—The deformity can only be corrected if an anæsthetic is given and the foot forcibly reduced either manually or with a wrench.

5. *Permanent Flat-Foot.*—Changes in the bones and arthritis have supervened.

Signs and Symptoms.—There may be no symptoms of any kind with well-marked flat-foot. In most cases, while the deformity is developing, burning pain or aching after standing or walking and weakness

of the foot are noticed. The toes are turned outwards (splay feet), the sole is flat, and the inner border of the foot convex and lengthened. There may be some localized œdema, and the skin along the inner border of the foot and on the outer side of the little toe is thickened and painful.

Ætiology—1. *Congenital*.—This is due to mal-development of the tarsal bones and failure of the muscles to maintain the arch.

2. *Static*.—This occurs when there is a general loss of muscle tone, as in convalescence after illness or childbirth, or when growth is rapid. Excessive fatigue after prolonged standing may produce flat-feet in policemen, nurses, etc., while a sudden increase in weight is a common cause, and varicose veins are often also present.

3. *Spastic*.—A type associated with peroneal spasm, the cause of which cannot usually be found.

4. *Paralytic*.—Found in diseases such as poliomyelitis.

5. *Inflammatory*.—Follows fibrositis of the plantar ligaments due to gonorrhœa, influenza, septic infections, or the acute fevers.

6. *Traumatic*.—After fractures round the ankle joint, especially Pott's fracture.

Treatment.—Many people with rigid flat-feet are able to pursue their occupations with no disability, and treatment should only be instituted for the relief of pain and the restoration of impaired function. The aim should be to transfer the body weight to the outer side of the foot, and also to relieve pressure symptoms.

1. *Incipient Flat-Foot*.—Rest in bed during the acute stage should be combined with massage, electrical treatment, exercises, and correction of footwear with a wedge on the medial side of the sole.

2 and 3. *Voluntary Flat-Foot and Resistant Flat-Foot*.—An arch support of felt or sponge rubber or a Whitman's valgus brace may be used in addition to the above measures.

4 and 5. *Rigid and Permanent Flat-Foot*.—Symp-

toms are generally due to adhesions or osteo-arthritis changes in the tarsal joints. Manipulation under anæsthesia, either manually or with a Thomas's wrench, should be followed by a course of vigorous exercises. If the treatment is not successful, operation must be performed. Astragalo-scaphoid arthrodesis should be carried out, and if necessary combined with a reconstructive shortening of the fore-foot or the insertion of a wedge from the scaphoid into the antero-lateral part of the os calcis.

Pes Cavus, or Claw-Foot.—The longitudinal arch of the foot is raised and the toes contracted (hammer-toes). The deformity may be congenital or result from infantile paralysis, lesions of the central nervous system such as Friedreich's ataxia, or inflammatory contracture of the sole. Most cases, however, are idiopathic. Varying degrees are found from slight extensor weakness to a stage in which the metatarsal heads project downwards, the toes are flexed, and the foot contracted into a varus or equino-varus position. There may be severe pain and disability, with callosities over pressure points and blue cold toes.

Treatment.—A transverse leather bar (a metatarsal bar) behind the metatarsal heads placed across the sole suffices for mild cases. Division of the plantar fascia and transplantation of the extensor proprius hallucis tendon through a hole in the neck of the first metatarsal, followed by wrenching the foot and a plaster-of-Paris case for three to four weeks, may be necessary. In severe cases Steindler's 'muscle-slide' operation on the muscles and fascia attached to the os calcis is performed. In the worst cases some form of reconstruction of the bones of the foot or removal of the toes, the metatarsal heads, and the astragalus is called for.

Hallux Valgus.—The big toe is turned outwards, the first metatarsal inclines inwards, exposing the inner part of its head to abnormal pressure, resulting in a form of osteo-arthritis. A bursa forms over the metatarsal head and may become inflamed (bunion) or suppurate. The wearing of pointed shoes is often

the cause, the other toes being crowded together and deformed. The condition is much more common in women.

Treatment.—Specially constructed boots with a metatarsal bar should be combined with manual correction and foot exercises. Advanced cases may need: (1) Removal of exostoses and the overlying bursa. (2) Arthroplasty of the affected joint, including excision of the upper and inner part of the metatarsal head. (3) Removal of the base of the first phalanx combined with arthroplasty. (4) Cuneiform osteotomy of the metatarsal base after removal of exostoses and the bursa. On no account should the whole of the metatarsal head be removed, as this inevitably leads to crippling.

• **Hallux Rigidus.**—There is stiffness of the metatarso-phalangeal joint of the great toe and absent dorsiflexion. In severe cases all movement is impossible and the joint becomes flexed (*hallux flexus*). The condition often occurs in young males with flat-foot, and may result from inflammation or from a traumatic lesion. Osteo-arthritis supervenes later. There is pain and swelling of the joint, and an exostosis appears on the dorsal aspect of the articular surface of the metatarsal head. In mild cases relief may be obtained by wearing a metatarsal bar, while in later cases manipulation under anæsthesia should be combined with division of the plantar ligaments of the joint. In cases associated with arthritis the base of the proximal phalanx should be excised.

Hammer-Toe.—There is hyperextension of the proximal phalanx, plantar flexion of the second, and flexion or extension of the distal one. Painful corns and bursæ form over the first interphalangeal joint or at the tip of the toe. The second toe is the one usually affected, often in association with *hallux valgus*. The condition is usually bilateral and may be congenital, but is generally due to wearing short pointed shoes with high heels.

Treatment.—Repeated manipulation followed by application of adhesive plaster to maintain correction may be sufficient in children, but in adults removal

of the corn and bursa and excision of the head of the first phalanx is generally necessary.

Metatarsalgia (Morton's Disease).—Neuralgic pain occurs below the heads and shafts of the metatarsal bones. The lesion may be *traumatic* (e.g., following falls from a height), *inflammatory* or *static*. The last type is commonly found when there is a rapid increase in body weight or in convalescence from an illness. The pain is due to stretching of the transverse ligaments of the metatarsal heads or to pressure on the digital nerves.

Treatment.—A shoe with a low heel, thick sole, high arch and a metatarsal bar should be worn. A pad of felt under the metatarsal arch or a Whitman's valgus brace may be necessary. When the symptoms have subsided, exercises, massage and manipulation are useful. Division of the digital nerves may relieve the pain, but if not resection of the head and neck of the affected metatarsal should be performed.

March Foot.—A fairly frequent cause of pain in young adults who have had to stand or walk for long periods. There is pain, swelling and tenderness on the dorsal surface of the second, third or fourth metatarsal bone. In the early stages X-rays show slight woolliness on one side of the neck due to the formation of subperiosteal new bone, and later there may be evidence of a definite fracture. In some cases it is possible to feel a bony swelling. In the acute stage treatment consists in relief from weight-bearing, either by rest in bed or by a light plaster.

CHAPTER XVI

ULCERATION AND GANGRENE

ULCERATION

Definition.—Destruction of the superficial tissues, including skin or mucous membrane.

Causes.—(1) *Trauma*: (a) Mechanical injury; (b) chemical; (c) thermal; (d) electrical; (e) X-rays

and radium; (f) long-continued pressure (bedsores). (2) *Bacterial infection*, one of the results of inflammation caused by pyogenic organisms. (3) *Deficient circulation*. Common examples are: (a) Endarteritis, associated with diabetes and syphilis; (b) varicose veins and their sequelæ, such as thrombosis. (4) *Deficient innervation*: (a) Spinal disease, particularly tabes; (b) peripheral neuritis associated with anæsthesia of the skin (trophic ulcers). (5) *Specific diseases*: (a) Tuberculosis; (b) syphilis. (6) *New growths* which infiltrate and replace skin or mucous membrane.

General Description.—The area denuded is termed the **surface**, where it meets the epithelium is the **edge**, the **margins** being the tissues immediately outside the edge, and the **base** those tissues underlying the denuded area.

Three stages of ulceration are recognized: (1) Spread of the destructive process (*extension*). (2) Separation of dead tissue and preparation for repair (*intermediate stage*). (3) Process of repair (*healing*).

1. *Extension*.—Surface covered with grey or yellow sloughs. Discharge profuse, thin, sero-purulent and offensive. Edge sharply cut. Margins inflamed and thickened. Base thickened and adherent to underlying structures.

2. *Intermediate*.—Surface smooth and glazed. Discharge scanty and serous. Edge rounded and raised. Margins not inflamed (congested in chronic ulcers). Base less adherent.

3. *Healing*.—Surface shelving and covered with healthy granulations. Discharge serous. Edge not raised and shows three coloured zones from without in—white, blue, red. Margins not inflamed. Base movable on underlying structures.

Chronic Ulcers (Indolent or Callous Ulcers).—Ulcers in which healing is long delayed.

Causes.—*General*: Diabetes, chronic nephritis, old age, alcoholism and prolonged standing.

Local: Defective circulation (*e.g.*, varicose veins); reinfection and constant irritation due to lack of cleanliness; and fixation to underlying structures by

fibrous tissue in the base, which also compresses the vessels supplying the granulations.

Special Types of Chronic Ulcer.—(1) *Varicose ulcer*: Most common on legs and feet. Nutrition of skin is permanently impaired owing to venous backflow from varicose veins while in the erect posture. Affected veins may be superficial or deep-seated. (2) *Eczematous ulcer*: Surrounded by an area of inflamed skin which discharges copiously. Frequently multiple, and usually superficial. (3) *Irritable ulcer*: Severe pain, especially at night, and extreme tenderness of base due to exposure of nerve terminals. Generally in neighbourhood of ankle. (4) *Perforating ulcer*: Usually on sole of foot under ball of big toe, and penetrating deeply into joints, which are disorganized. Remarkable absence of pain due to associated nervous disease (tabes or peripheral neuritis).

Treatment—Acute Ulcer.—This resolves itself into: (1) Removal of the cause. (2) Lotions and dressing to remove the necrotic tissue and assist the inflammatory process—peroxide of hydrogen, boracic fomentations. (3) Stimulation of granulations—hypertonic saline, lotio rubra (astringent solution containing zinc sulphate). (4) Protection of the delicate growing epithelium by emollient dressings and avoidance of too frequent dressing of the ulcer.

Chronic Ulcer.—A reflection on the causes of chronicity will indicate the special measures necessary in treatment. (1) General constitutional disease must be dealt with. (2) Everything possible must be done to improve the local circulation. Prolonged standing must be avoided, varicose veins must be treated by injection. Elastic pressure is of great value and may be applied in several ways: (a) Crêpe bandages and elastic stockings. (b) Unna's paste (zinc oxide and gelatine 5 parts each, boric acid 1 part, and water 6 parts); this is warmed and painted over a layer of gauze, covered by a thin bandage soaked in the paste and usually changed once a week. (c) Medicated elastic strapping which is applied directly to the ulcerated surface and combines pressure with medication. (3) Reinfection must be avoided by antiseptic

dressings or ultra-violet light applied locally. (4) Fixation to underlying structures necessitates operation, undermining and freeing the edges, and in some case excision of the ulcer. (5) Skin grafting.

Skin Grafting is the transplantation of skin from one part of the body to another (*autogenous graft*). Transplantation from another individual is only of value if donor and recipient are in compatible blood groups.

Essentials for success: (1) Freedom of the ulcer from infection; (2) surface must either be a clean recent wound or be covered by healthy granulations; (3) hæmostasis—eliminate oozing; (4) accurate apposition of the graft; (5) avoidance of tension; (6) no antiseptics; (7) rest—avoid too frequent dressing.

Methods—1. *Thiersch's Method*.—The best for most purposes. With aseptic precautions grafts are cut (usually from thigh) with lubricated razor, laid flat on ulcerated area, and close apposition to granulations effected by gentle manipulation with blunt end of needle, taking care to avoid infolding of edges. Grafts consist of large pieces of epidermis with some dermis, but various thicknesses can be utilized and adapted to varying requirements. Disadvantage of method is thin scar resulting and liability of grafts to die. Grafted area covered with fine protective gauze tissue, 'tulle gras,' or exposed to air, and left untouched for a week except for careful moistening daily with sterile saline.

2. *Pedicle and Tubular Grafts* consist of flaps of skin and subcutaneous tissue attached at one extremity to maintain their blood supply. These are transplanted by one or more stages to the ulcerated area, to the pared edges of which they are sewn. When they have acquired new blood supply from this end (usually in ten to fourteen days) the grafts are freed from their original connexions. Particularly useful in repair of facial deformities.

3. *Wolfe's Method*.—The whole thickness of the skin is removed, denuded of subcutaneous tissue and fat, the edges being stitched to those of the ulcer. To allow of shrinkage the graft is cut slightly larger

than the ulcer. Useful after removal of small tumours of the face and applied at the time of their excision.

4. *Reverdin's Method*.—The original method used in 1869, but hardly ever now. Small portions of skin were pinched up and removed by sharp curved scissors, the grafts consisting of both epidermis and dermis, which were placed here and there on the ulcer. Still valuable in conjunction with Thiersch's method.

GANGRENE

Definition.—Gangrene is death of macroscopic portions of tissue. If of soft parts, it is called *sloughing*; of bone, *necrosis*.

Signs.—(1) Loss of pulsation in the vessels. (2) Loss of heat. (3) Loss of sensation. (4) Loss of function. (5) Change of colour, to purple or mottled if much blood be present, to waxy colour if anæmic.

Types.—(1) Dry; (2) moist.

1. **Dry Gangrene** occurs when the part has previously been drained of its fluids by pre-existing disease. Usual cause is arterial thrombosis supervening on atheroma or calcification of vessels. The affected part becomes hard, wrinkled and black or dark brown in colour.

2. **Moist Gangrene** results when the tissues are full of fluid and is usually associated with venous as well as arterial obstruction. Two varieties are recognized: (a) Aseptic; (b) septic, the latter depending upon the supervention of gross bacterial invasion. In *aseptic moist gangrene* the part is of the same size and consistency as before the onset, the skin being purple, green or white. In *septic moist gangrene* the tissues become soft and diffuent, bubbles of offensive serum and gas appear in blebs on the skin and the colour is black, green or yellow.

Pathological Changes.—Invasion of the dead tissue by phagocytes (leucocytes and endothelial cells) occurs and a zone of granulation tissue develops at the junction of the living and dead areas. In aseptic gangrene of small areas complete absorption of the gangrenous part occurs; more usually the dead tissue

is gradually separated and the site of junction is called the **line of demarcation**. In septic gangrene acute inflammation and suppuration of the living tissues is superadded. Separation is accompanied by destruction of more tissue and there is a marked tendency for the septic process to spread not only by lymphatics and veins, but also along fascial and muscular planes.

General Symptoms.—1. Those of the predisposing disease, defective circulation from fatty heart, valvular lesion, or calcareous arterics, and diseases such as diabetes and albuminuria.

2. Those due to absorption of toxins, causing fever and exhaustion. Pain is a frequent and troublesome symptom.

Treatment is local and general. Local will be dealt with under the various headings. General treatment consists in good feeding, giving stimulants, sedatives for pain and control of diabetes if present.

Varieties.—1. *Direct Gangrene* may be due to (a) crushing injuries; (b) pressure; (c) acute inflammation; (d) heat or cold; (e) X-rays and radium; (f) chemical corrosives—*e.g.*, carbolic acid.

2. *Indirect Gangrene* is death of a part due to a cause acting at a distance such as (a) disease of bloodvessels causing gradual diminution in calibre (arterio-sclerosis, endarteritis obliterans); (b) sudden obstruction of vessels (embolus, injury); (c) imperfect innervation; (d) general causes—diabetes, acute fevers and ergot.

3. *Infective Gangrene* is due to specific infective organisms.

Bedsore.—Occur in patients kept long in the recumbent posture or in one particular position, especially if sensation is impaired or the part is allowed to remain moist or contaminated with fæces or urine.

To prevent bedsore, the position of the patient should be changed frequently, a water pillow or bed should be used, and the part kept thoroughly dry and clean. If a bedsore threatens, a ring pillow should be used, the skin hardened by massage with spirit, and the part dusted with a powder containing boric

acid, zinc oxide and starch. If a bedsore forms it should be kept strictly aseptic.

Pressure Sores.—Splint pressure may produce local gangrene, especially over bony prominences such as the heel. Neuralgic pain is complained of, but if this warning is neglected, the pain goes off after a time and a slough is discovered later when the splint is removed.

Senile Gangrene.—The blood supply, usually of the lower extremity, is reduced by calcareous degeneration of the main vessels. The limb only obtains sufficient nutriment to meet ordinary requirements. Any slight injury or inflammation is sufficient to produce gangrene. The toes are most frequently affected, but the hands, nose, or ears may be.

Symptoms.—Before gangrene occurs, evidence of imperfect blood supply is present, such as coldness of the feet, numbness, tingling, cramps in the muscles.

Local Signs.—If due to inflammation, a red, painful area appears and becomes a slough. If due to thrombosis of vessels, the part simply shrivels up and dies. The inner side of the big toe is a common site. The gangrene may spread to other toes and along the foot. The disease may be arrested at any stage or sepsis may occur and add to the severity of the affection. Pain is a very marked and exhausting symptom of senile gangrene.

Treatment.—A patient with signs of malnutrition of the feet should avoid cold and injuries. Directly gangrene has occurred, the part must be disinfected and wrapped in sterile gauze. It should also be rested, kept warm, and elevated. Opium should be given for pain and the diet should be nourishing. The question of amputation must arise. If the line of demarcation is well defined and localized, and there is little evidence of toxæmia, the dead part may be left to separate; otherwise amputation must be carried out at the lowest point at which the vessels can be felt pulsating. Lumbar sympathectomy is of value in selected cases.

Embolic Gangrene.—This results from blockage of the main artery by an embolus. The limb becomes

pallid at first and afterwards dark. When embolism occurs, there is violent pain at the site of blockage, but thrombosis may extend upward from this.

If a sufficient collateral circulation is established, gangrene does not occur, but if the patient is debilitated, as in embolism from detachment of a vegetation during the course of endocarditis, gangrene is very likely to follow. Emboli are commonly arrested at the site of bifurcation of arteries.

Gangrene extends upwards till it reaches a level where the circulation is sufficient to maintain vitality. Generally this is about a joint, where there is usually a free anastomosis.

Treatment.—In the early stages of threatened gangrene due to an embolus, the question of embolectomy must be considered. If after twenty-four hours the part does not change in colour on pressure with the fingers, gangrene has occurred, and it is better to amputate at once 2 or 3 inches above the limit of gangrene.

Symmetrical Gangrene may occur as the result of Raynaud's disease. It affects the fingers of anæmic, neurotic women between eighteen and thirty years of age. The attacks are brought on by cold. There are three stages: (a) Local ischæmia from arterial spasm, with pallor and pain in the part; (b) local congestion, with blueness from venous engorgement; and (c) necrosis, in which small areas of skin slough.

Treatment.—Attend to the patient's general health, while locally friction and electricity are the most beneficial agents. Ganglionectomy may be of more than temporary value, but the final result is often disappointing.

Diabetic Gangrene.—In diabetes three causes contribute to the onset of gangrene: (a) The lessened resisting power due to the abnormal condition of the blood; (b) peripheral neuritis; (c) endarteritis. Any slight injury or infection in a diabetic may set up gangrene, which is usually dry at first, but often develops into the moist variety later.

Treatment.—General treatment aims at controlling the diabetic condition, particularly acidosis, by regula-

tion of carbohydrate intake combined with the use of insulin.

Local: Early amputation well above the gangrenous area. There is danger of coma after operation, but as the great majority die from sepsis or coma if not operated upon, early amputation produces the best results. Use spinal anaesthesia combined, if necessary, with nitrous oxide gas and oxygen.

Gangrene after Acute Fevers is due to arterial thrombosis.

Gangrene after Ergot is due to eating bread made from rye infected with the ergot fungus (*Claviceps purpurea*).

Gas Gangrene.—Infective gangrene due to spore-bearing anaerobic bacilli of the Clostridium group. *Cl. welchii* alone may be responsible, but *Cl. septicum* and *Cl. oedematiens* are frequently present. Aerobic organisms such as *Streptococci*, *Staphylococci*, *Proteus vulgaris*, *Pseudomonas pyocyanea* and *Bact. coli* are often found. It must be remembered that many of the above organisms may be present in an infected wound without gas gangrene developing. The deciding factor would appear to be **necrosis of the tissues**, especially the muscles, from direct trauma, interference with the blood supply, the action of chemicals—e.g., antiseptics—or from aerobic bacterial action. Foreign bodies such as pieces of clothing act as a focus for anaerobic infection.

Signs and Symptoms.—The onset is acute and the infection spreads rapidly. It may commence within a few hours of the injury or be delayed for several days. A rapid pulse with little or no drop in blood pressure should arouse suspicion. Vomiting may be the first symptom, and pain is sometimes acute in the injured part. The temperature may be raised or subnormal, and the patient is often anxious and alert. Locally the following points may be noted:

1. *The Wound* is dry, but a watery exudate with gas bubbles may exude on pressure in the early stage. Later there is more discharge, which is dark and offensive, and has a characteristic mousy odour.

2. *Swelling of the Limb.*—This may be localized or more widespread.

3. *Crepitation.*—May be felt over a wide area from escape of gas into the subcutaneous tissue, but it does not follow that such a wide area is infected.

4. *Tympanitic Note.*—Can usually be detected on light percussion.

5. *Skin Changes.*—Pallor is followed by a dirty brown colour with purplish mottling, and finally greenish-yellow areas and blebs. Bronzing of the skin is seen in retroperitoneal infections.

6. *At operation* the affected muscles show characteristic changes: (a) loss of contractibility and failure to bleed; (b) brick-red colour; (c) presence of gas bubbles; (d) dark green or black colour, and softening at a later stage. A ridge may be felt between normal and infected parts of a muscle, due to swelling of the affected fibres.

X-rays may reveal the presence of gas in the wound area, *but this fact does not necessarily indicate gas-gangrene infection.*

Treatment.—Early and thorough wound excision, (see p. 46) is of the greatest importance in prophylaxis. It should be combined with injection of polyvalent gas-gangrene antitoxin intravenously or intramuscularly; 3,000 international units of *Cl. welchii* antitoxin together with 1,500 units of *Cl. septicæ* and 1,000 units of *Cl. œdematiens* antitoxin are given. Chemotherapy is also recommended: 4 to 5 grammes of sulphanilamide or sulphapyridine during the first day; 3 grammes on each of the three succeeding days (total=13.5 grammes).

If gangrene has set in a dose of 3 grammes of sulphanilamide should be given orally two hours before operation. The wound must then be widely opened up and the affected muscle or group of muscles excised. Amputation must be considered in severe cases. Full doses of sulphonamide (see p. 15) are given, and also intravenous injections of polyvalent antitoxin while toxæmia continues.

Cancrum Oris and Noma are two forms of spreading gangrene affecting respectively the mouth and vulva

of children from two to five years of age. It occurs in weakly children convalescing from one of the acute exanthemata, especially measles and scarlatina.

In the mouth an inflammatory spot appears, spreads rapidly, becoming at first black and gangrenous and later grey and pultaceous. The breath is foetid and there may be destruction of the whole thickness of the cheek and part of the jaw. Toxæmia is severe with a high temperature, and pyæmia, from septic thrombosis of the facial vein, or septicæmia may follow. Death usually occurs in three to four days.

The responsible organisms are *Streptococcus hæmolyticus* and probably Vincent's bacillus.

Treatment must be prompt. All the gangrenous parts must be cut away until a bleeding surface is exposed, which is then painted with fuming nitric or pure carbolic acid. The mouth should be frequently washed out with antiseptic lotions. The child should be well fed and given stimulants.

CHAPTER XVII

FRACTURES AND DISLOCATIONS

FRACTURES

A FRACTURE is a sudden loss of continuity in a bone produced by some form of violence.

Causes of Fracture.—(1) Direct violence, in which fracture occurs at the point struck. (2) Indirect violence, in which the bone is broken at some distance from the site of violence, the bone being bent beyond the limits of elasticity; the line of fracture is oblique or spiral. (3) Muscular action is a common cause of fracture of small bones and bony prominences, such as the patella and olecranon.

Varieties of Fractures.—1. *Simple or closed*, having no communication with the exterior.

2. *Compound or open*, communicating with the exterior.

3. *Incomplete* : (a) Greenstick; (b) fissured; (c) depressed.

4. *Complete* : Transverse, oblique, spiral or longitudinal.

5. *Comminuted* : Broken into a number of small fragments.

6. *Impacted* : One fragment is wedged into another.

7. *Complicated* : Associated with injury to vessels, nerves or joints.

8. *Epiphyseal fracture* (separation of epiphysis) occurs before the age of twenty-five, usually in the humerus, radius or femur. A portion of the diaphysis is usually broken off as well and the periosteum remains adherent to the epiphysis. Growth of the bone may be interfered with and deformity result. Partial separation (juxta-epiphyseal strain) occurs.

Repair of Fractures.—(1) When a fracture occurs, extravasation of blood follows around and between the broken ends and clotting takes place (fracture hæmatoma). The calcium and phosphorus content of this hæmatoma are increased by *decalcification* of the bone ends which is caused by *hyperæmia* following the injury. Any interference with this hæmatoma (e.g., by aspiration or open operation) alters the pH and may result in delayed union. (2) Leucocytes and fibroblasts infiltrate and absorb the clot, which is replaced by granulation tissue (seven to ten days). (3) The latter is invaded in approximately two months by bony trabeculæ and cartilage cells, not only in the medullary cavity (internal callus), but also between the bone and the stripped-up periosteum (external or ensheathing callus), and lastly between the bone ends (intermediate callus). (4) Final consolidation of the bone ends takes place by the formation of mature bony lamellæ, while the medullary cavity is re-invaded by fat and marrow cells (three to six months).

Factors influencing Repair.—1. *Persistent hyperæmia* of the injured area from any cause prevents the deposition of calcium salts in the granulation tissue and delays union. The most important cause of persistent hyperæmia in closed fractures is *imperfect immobiliza-*

tion of the fragments, whereas in open fractures infection is an added factor.

2. *Blood Supply*.—Impairment or deprivation of the vascularity of one or both fragments will result in delayed union or non-union. Some parts of the bones have a more liberal blood supply than others. Extensive stripping of the periosteum further diminishes the circulation and leads to slower union.

3. *Age*.—The younger the patient, the more readily do fractures unite.

4. *Type of Fracture*.—Oblique and spiral fractures have a large vascular area and unite faster than do transverse ones. Impacted fractures unite faster than those with a gap. Excessive traction may cause or widen a gap and thereby impair union.

5. *General causes*—*e.g.*, malnutrition or cachexia.

Delayed Union and Non-Union.—Failure to immobilize a fracture adequately for a sufficient period is undoubtedly the main factor causing delayed union or non-union. Other causes may be tabulated as follows: (1) Want of apposition or extensive loss of bone substance. (2) Presence of muscle, fibrous tissue, tendon, synovial fluid or loose bone between the fragments. (3) Local diseases of bone—*e.g.*, osteomyelitis in compound fractures, neoplasms. (4) General bone disease—*e.g.*, osteitis deformans, osteomalacia. (5) Constitutional diseases. (6) Operative interference and the introduction of foreign bodies—*e.g.*, metal plates.

Adhesions and Joint Stiffness.—The immobilization necessary to procure union of a fracture involves fixation of one or more joints, and is responsible for subsequent adhesions and joint stiffness. It is of vital importance to minimize this crippling complication by active exercise from the day of injury of the muscles and tendons in relation to the immobilized joints. This also prevents disuse atrophy of the affected muscles and expedites a return to normal activity after the removal of the splints. Free active movement of the non-immobilized joints of a fractured limb should also be insisted upon from the first. Passive stretching is to be avoided at all costs, as it

leads to further exudate and more adhesions. Manipulation under anæsthesia may produce a similar result if performed too early, though gentle manipulation may assist recovery of movement at a later stage when no further improvement follows from active exercise. The insertion of skeletal traction pins near joints and the introduction of foreign bodies for fixation of fractures involving joint surfaces may increase adhesions and stiffness.


Avascular Bone Necrosis.—In some fractures a portion of the bone is cut off from its blood supply and undergoes necrosis. The dead bone retains its original calcium content while the surrounding bone is being decalcified as the result of hyperæmia (see p. 195). Radiographically the sequestrum appears as a dense shadow six to eight weeks after the fracture. Provided fixation is maintained sufficiently long, the dead bone is gradually replaced by granulation tissue which is eventually ossified. This process may take from one to two years, and it is essential that immobilization is kept up until union is complete. This can only be ascertained radiographically when the dense shadow of the dead bone is no longer to be seen and continuity is restored.

If a piece of articular cartilage is included in the avascular necrotic fragment, repair is largely by fibrous tissue and fibro-cartilage, and degenerative arthritis with progressive narrowing of the joint space causing serious restriction of movement is almost inevitable.

Traumatic Ossification (Myositis ossificans).—Fractures near joints, particularly the elbow in children, are liable to be followed by the formation of irregular bony masses in the neighbourhood of the fracture, probably caused by ossification in the displaced periosteum. Early movement is an important contributory factor, especially passive stretching. The affected part should be rested for several weeks and gentle active exercises then initiated (see p. 117).

Diagnosis of Fractures—1. Clinical.—In many cases examination of the injured area discloses *local swelling, bruising* and *deformity*, and the patient is

unable to move the limb. Manipulation may elicit *abnormal mobility* and grating or *crepitus*, but should be avoided owing to the pain caused, and the risk of inflicting damage to vessels or nerves. *Localized bone tenderness* should always arouse suspicion.

2. *Radiographic*.—Films should be taken in at least two planes at right angles to each other, and should include the whole length of the bones under examination. In some situations—*e.g.*, spine, wrist and ankle—radiograms should be taken in three to four planes and with the joint in different positions. In doubtful cases it may be advisable to repeat X-ray examination after an interval of several weeks when, owing to decalcification which has occurred since the first examination, a crack may be apparent (*e.g.*, carpal aphoid).

Treatment of Simple Fractures.—There are three essentials: (1) Reduction; (2) Immobilization; (3) Restoration of function.

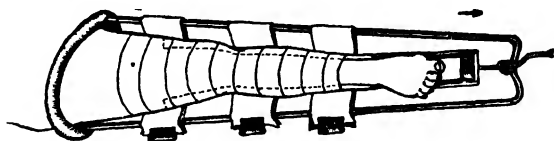
1. *Reduction*.—This may be effected by (a) manipulation, (b) traction and counter-traction, or (c) open operation.

(a) *Manipulation*.—Provided the condition of the patient permits, the sooner this is attempted the better. Muscular relaxation is essential, and to obtain it general anæsthesia or infiltration at the site of fracture with novocaine 1 to 2 per cent. is usually necessary. Radiograms should be taken before and after each attempt at reduction, and at intervals later to ascertain if redisplacement has occurred.

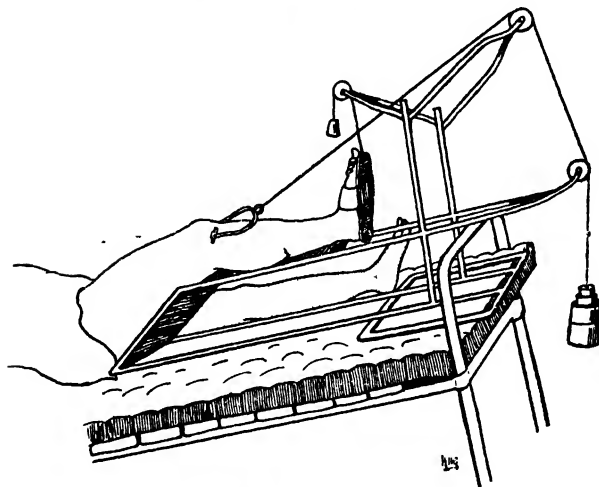
(b) *Traction and Counter-Traction*.—This is necessary when there is much overlapping of the fragments due to muscular spasm and in certain fractures (*e.g.*, Bennett's fracture) which are mechanically unstable. Traction is maintained by means of adhesive strapping applied to the skin, or by bony transfixion distal to the fracture using Kirschner's wire or Steinman's metal pin. *Fixed* traction is the term applied to traction from a fixed point—*e.g.*, Thomas' splint with no weight extension; in *balanced* traction weights are applied to the distal end and the body-weight is made to provide counter-traction by tilting the bed.

(c) *Open Operation.*—Manipulation or traction may occasionally fail to effect reduction, and open operation is then indicated.

2. *Immobilization.*—If reduction by manipulation



(a) Fixed traction.



(b) Balanced traction.

FIG. 9.—FIXED AND BALANCED TRACTION.

is successful, the best method of maintaining immobilization is by *plaster of Paris*. This may be applied direct to the skin or over a layer of vaseline, stockinette or wool. Special care must be taken to protect bony prominences with pads of adhesive felt. Slabs

of plaster are moulded to the part and the limb encircled by a plaster bandage.

Splints made of metal, wood and other materials are employed, especially when traction is being maintained.

Open operation is indicated for the fixation of certain types of fracture—*e.g.*, high fractures of the femoral neck, fractured patella and olecranon, etc. Metal or bone plates, screws, encircling wire or bands and metal or ivory pegs are employed to fix the fragments.

3. *Restoration of Function.*—From the moment a fracture has been immobilized every effort must be made to encourage functional activity. This promotes repair, assists the circulation, maintains muscle tone and joint movement. Every joint which need not be fixed must be actively exercised and the patient made to use the part to the best of his ability.

Treatment of Delayed Union and Non-Union.—Some fractures are naturally slow in uniting, but the term *delayed union* should be reserved for those in which there are characteristic radiographic appearances—*viz.*, broadening of the fracture line to a cavity with a hazy outline due to decalcification. In most cases inadequate immobilization has been the main cause, and the treatment lies in prolonging immobility for weeks or months until the usual radiographic appearances of a fracture are evident and there is clinical union.

Non-union is present when the broken ends of the bone have become sclerosed and the space between is filled with fibrous tissue or converted into a false joint. The essential part of the treatment is revascularization of the sclerosed area. The bone ends may be drilled in many directions or the sclerosed parts excised. Bone grafting ensures a free blood supply in addition to immobility.

Bone Grafting.—This may be carried out by one of four methods: (a) Simple inlay; (b) diamond inlay; (c) onlay; (d) intramedullary.

(a) *Simple Inlay* (Albee).—After freshening of the bone ends and excision of scar tissue, periosteal flaps

are reflected and a bed cut for the graft by means of a twin saw. The graft is usually taken from the tibia and should fit so accurately that it can only just be forced into its bed. An alternative method is to slide down a slightly wedge-shaped portion of the cortex of one fragment into a gutter prepared in the other fragment (sliding inlay).

(b) *Diamond Inlay* (Gallie).—This ensures removal

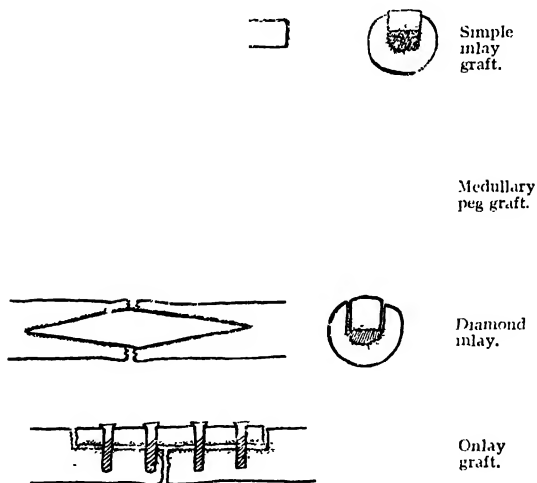


FIG. 10.—METHODS OF BONE GRAFTING.

of ample sclerosed bone, but does not immobilize the fragments so effectively.

(c) *Onlay*.—This has many advocates. The disadvantage is that the graft must be fixed by foreign bodies such as screws of beef bone or ivory, and these tend to work loose or break.

(d) *Intramedullary*.—A method seldom employed, as the medullary cavity is thereby blocked, the graft tends to break and rotatory movement is possible.

Whichever method of grafting is employed, external splinting of the limb is necessary until union is consolidated.

Open and Infected Fractures.—An open or compound fracture carries with it the grave danger of infection, and for this reason operation should be undertaken at the earliest opportunity that the patient's condition permits. It may be taken as an axiom that infection is inevitable if more than eight hours have elapsed since the injury. The patient's life or limb may thereby be seriously threatened and in all cases union is delayed, while sloughing of the soft tissues is liable to lead to permanent incapacity.

Treatment.—The patient is anæsthetized and the skin of the injured part is thoroughly cleaned with ether soap followed by surgical spirit. With strict aseptic precautions the bruised margin of the skin is excised, lacerated fascia and muscle removed as completely as possible without endangering the main vessels and nerves, and loose fragments of bone removed. In a few cases where the skin has simply been punctured, the wound can be closed by a few sutures. In the majority it is advisable to pack the cavity loosely with plain or vaselined gauze and to leave it widely open. In all cases the use of antiseptics is to be condemned, and suture of muscles and fascia with catgut should only be performed in the small group of cases in which all dead and soiled tissue is known to have been removed.

If the fracture can be reduced by manipulation, the most effective method of securing adequate immobilization is by application of plaster of Paris. The skin is covered with vaseline before the limb is encased. Provided the patient's temperature remains below 100° F. the plaster is not removed for two to three weeks, and when this is done secondary suture of muscles and skin may be performed and a fresh plaster applied.

In those open fractures where through delay in efficient treatment infection has set in, the wound should be thoroughly opened up, necrotic tissue and foreign bodies removed, gauze lightly packed in the

cavity and plaster of Paris applied. The temperature is watched, and if the patient is comfortable the plaster is not disturbed for several weeks. Pus exudes through and from underneath the plaster, producing an offensive odour which can be mitigated to some extent by deodorants. Burning pain indicates an acute dermatitis due to the pus reaching the skin, and is prevented by liberal use of vaseline before the plaster is applied. As soon as the plaster becomes soft it needs changing, and the wound will be found to be filling up with granulation tissue pushing the gauze pack out. It is again packed lightly. Gradually the granulations reach the surface and secondary skin suture or grafting can be considered. From the time the wound is healed immobilization must usually be continued for several months, as union of infected fractures tends to be very slow.

In some open or infected fractures reduction can only be effected by skeletal traction and in these plaster is impracticable. Various forms of metal splints which are employed will be mentioned in the appropriate section.

Pathological Fractures.—Owing to abnormality of one or more bones, fracture may result from comparatively slight violence (spontaneous fracture). The causes may be classified as follows:

1. *Congenital*.—Osteogenesis imperfecta (fragilitas ossium) is a rare disease of well-marked hereditary and familial tendency. Multiple fractures may occur *in utero* (foetal type), during infancy (infantile type), or during adolescence (adolescent type), after which the liability to this type of fracture disappears.

2. *Deficiency Diseases*.—Cœliac disease of children, steatorrhœa of adults, osteomalacia and tropical sprue cause osteoporosis.

3. *Atrophy*.—This may result from senility, disuse due to prolonged recumbency or paralysis.

4. *Nervous Diseases*—*e.g.*, tabes dorsalis, syringomyelia, general paralysis of the insane and poliomyelitis.

5. *Local Bone Disease*.—(a) Inflammatory—osteomyelitis, syphilis and tuberculosis; (b) bone tumours

and cysts—solitary bone cysts, secondary carcinoma (especially of breast, prostate and kidney), primary sarcoma of bone and various innocent growths, such as giant-cell tumour and chondroma.

6. *General Osteitis Fibrosa*.—In the parathyroid type decalcification of the bone is the result of adenoma or hyperplasia of the parathyroid glands.

7. *Osteitis Deformans and Myelomatosis*.

Many pathological fractures unite readily.

DISLOCATIONS

A dislocation is a condition of displacement of the ends of the bones entering into the formation of a joint and usually occurs in the middle period of life as the result of indirect violence. In some cases the dislocation is predisposed to by congenital malformation of the joint (*e.g.*, the hip, p. 170), in others to pathological changes in the joint (*e.g.*, septic arthritis).

Subluxation is the term applied to an incomplete dislocation, the joint surfaces being still partially in contact. A dislocation is *compound* or *open* when it communicates with the external air, *complicated* when important vessels or nerves are injured. *Fracture-dislocation* implies a fracture near the dislocated end of one of the bones involved.

Signs.—(1) Pain, bruising and swelling; (2) deformity; (3) limited mobility.

Lacerations of the capsular and other ligaments, muscles and tendons, with extravasation of blood into the joint and surrounding tissues, are followed, if the dislocation is unreduced, by the development of fibrous tissue in both the articular cavity and peri-articular structures; the displaced bone loses its articular cartilage and becomes embedded in dense adhesions, or a false joint is formed. Muscles and tendons become shortened and adhesion of the bones to large vessels or nerves may develop. Reduction of dislocations is essential, but may be prevented by (i) muscular contraction, (ii) shape of the articular surfaces, (iii) interposition of capsule, muscles or tendons.

Treatment.—Skiagrams of the joint should be taken, if practicable before reduction, and always afterwards.

1. *Manipulation.*—The method of choice. The displaced bone is made to retrace the course by which it left its proper position. Anæsthesia facilitates this by relaxing muscles.

2. *Extension.*—This overcomes muscular contraction, counter-extension being supplied either by an assistant or by the knee or foot of the surgeon.

3. *Open Operation.*—In fracture-dislocation, or dislocation complicated by injury to important vessels or nerves, this is often necessary.

After-Treatment.—As a general rule the joint is rested for several weeks before active exercises are started.

Unreduced Dislocations.—In the treatment of these the following principles should be observed:

1. *Reduction.*—This should not be attempted after three months have elapsed since the injury, and is seldom of use after four to six weeks.

2. *Massage and Manipulation.*—Should be tried if movement is free and painless, and a useful limb may result.

3. *Open Operation.*—Indicated in cases with poor movement and pain, also in young working men and in joints of the upper extremity. The best results follow excision of the end of the displaced bone, whereas attempts at reduction are dangerous and little improvement ensues.

CHAPTER XVIII

INJURIES OF THE UPPER LIMB

THE SHOULDER

INJURIES to this region are usually the result of falls on the shoulder or the outstretched hand, and are usefully subdivided into: (1) Bone and joint injuries, (2) capsule and tendon injuries.

I.—BONE AND JOINT INJURIES.

1. **Fractured Clavicle.**—Commonly broken, usually from indirect violence, such as a fall on the hand or shoulder. Occurs frequently in children, and may be of the greenstick variety. The fracture may be in one of three places:

(a) *Middle Third.*—By far the most common. The fracture is oblique and the displacement characteristic. The shoulder, and with it the outer fragment, is depressed, rotated forwards, and drawn inwards. The inner fragment retains its normal position, being held by the rhomboid ligament, so that the outer end is easily felt under the skin, and appears to be drawn up. The displacement is due to the weight of the arm pulling down the outer fragment.

(b) *Acromial End.*—Little displacement results if the fracture is between the conoid and trapezoid ligaments, but crepitus and signs of local injury are present. If outside the trapezoid ligament, the outer fragment is displaced downwards and forwards.

(c) *Sternal End.*—Rare, and produces little displacement.

Complications.—Only occur when direct violence is the cause of fracture. Pressure on the brachial plexus is the most common, but the subclavian artery or vein, the pleura, or lung may be injured.

^ **Treatment.**—Union occurs readily and displacement is overcome easily in most cases by drawing the shoulder girdle upwards and backwards. Displacement tends to recur, and the most effective methods of preventing this are:

(1) *A figure-of-eight bandage* crossing over the back is applied over a pad in each axilla, the shoulders being pulled backwards at each turn of the bandage. If the bandage works loose it must be reapplied every few days, and is discarded after three weeks. The arm is kept in a sling for at least a week. The fingers, wrist and elbow must be exercised from the beginning, the shoulder after a few days, especially in older patients.

(2) A padded wash-leather-covered ring is fitted so as to lie internal to the head of the humerus in each axilla. A wide webbing strap unites the two rings anteriorly and two similar straps are then adjusted posteriorly so as to pull the shoulders backward, the affected hand being slung loosely, pointing towards the opposite shoulder.

(3) *Recumbency*.—This is the best method of avoiding deformity. The patient should be kept for three weeks with the head low and a pad between the shoulders.

2. **Dislocations of the Clavicle**.—(a) *Sternal End*.—The displacement may be forwards, upwards or backwards. In the latter pressure on the trachea may cause dyspnoea. Reduction is usually simple, and effected by pulling the shoulder outwards and backwards. The position is maintained by a figure-of-eight bandage applied as above. Recurrent dislocation or subluxation may need operative treatment, capsular suture being reinforced by fascial grafts.

(b) *Acromial End*.—Displacement is usually upwards, and may be incomplete (subluxation) or complete, when the conoid and trapezoid ligaments are torn. Reduction is easy but difficult to maintain owing to the weight of the arm. While the arm is being supported, turns of strapping are applied from the supraclavicular triangle to the elbow. A collar-and-cuff sling is employed during the period of fixation, which should be three weeks for subluxation and five weeks for complete dislocation. In old unreduced and recurrent dislocations, if causing pain and disability, operative reduction and fixation of the bones with fascial strips is indicated.

3. **Fractured Scapula**.—Fractures of this bone are uncommon.

(a) *Body*.—Caused by direct violence, often comminuted with slight displacement of the fragments. Treatment is by firm strapping.

(b) *Neck*.—The fracture extends from the axillary border to the supraclavicular notch. There is flattening of the shoulder and lengthening of the arm. In younger patients displacement should be corrected

by a traction, abduction frame applied for four to six weeks. This method is precluded in older patients owing to the risk of a stiff shoulder, and in these the limb should be supported in a sling or abduction frame, early active movements being instituted.

(c) *Coracoid Process*.—Broken by direct or muscular violence with little displacement. The arm should be kept in a sling.

(d) *Acromion Process*.—Displacement is slight and firm strapping with a collar-and-cuft sling is sufficient.

4. **Fractured Upper End of Humerus**—(a) **Great Tuberosity**.—Direct violence may cause a comminuted fracture involving most of the tuberosity, whereas muscular pull may avulse a small chip in the region of the insertion of the supraspinatus and less commonly of infraspinatus, teres minor or subscapularis. If there is no displacement, the limb is kept in a sling for ten to fourteen days, early active exercises being employed to minimize adhesions. Where retraction of the fragment has occurred, the shoulder should be abducted and externally rotated, and maintained in this position for six to eight weeks by a plaster spica or an abduction frame.

(b) **Neck**.—Three types occur: (1) contusion crack, (2) adduction fracture, and (3) abduction fracture. The first is due to direct violence, the others to falls on the outstretched hand.

(1) *Contusion cracks* are associated with a fractured great tuberosity, and as there is no displacement a sling suffices; active exercises should be started early.

(2) In *adduction fracture* the fragments are angulated outwards and impacted on the inner side. In younger patients reduction should be brought about by traction and abduction in a frame for four weeks. In older patients this treatment may result in serious restriction of shoulder movements from adhesions, and it is wiser to ignore the displacement and to initiate active exercises at once.

(3) *Abduction fracture* results in inward angulation at the site, the shaft being abducted in relation to the head with impaction on the outer side. This is the most common of all shoulder injuries. The limb

should be carried in a collar-and-cuff sling and shoulder movements commenced in ten to fourteen days. Occasionally there is no impaction of the fragments in this type of fracture, and in this event reduction by manipulation should be tried. If unsuccessful, continuous traction by strapping in a

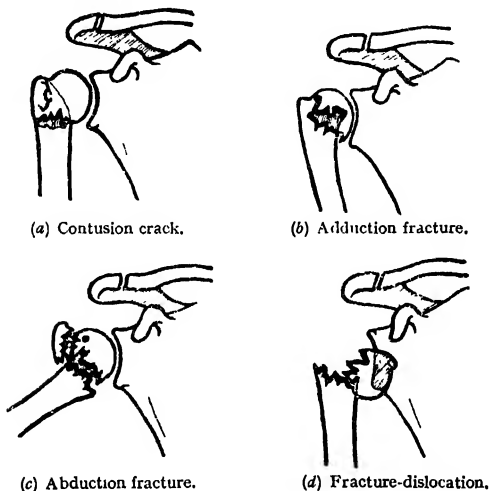


FIG. 11.—FRACTURED NECK OF HUMERUS.

special abduction frame for three to five weeks is called for.

(c) **Fracture-dislocation.**—Fracture of the humeral neck may complicate subcoracoid dislocation of the shoulder. The head of the humerus lies almost upside down, while the arm hangs by the side. Reduction should be attempted by strong traction with the arm fully abducted, accompanied by digital pressure on the humeral head. If this fails, operative reduction is the alternative.

5. **Dislocated Shoulder.**—The commonest dislocation met with in adults. The humeral head tears the capsule on the weak inner aspect and usually lies below the coracoid process (*subcoracoid*). More rarely it may be *subglenoid*, *subclavicular*, or if it passes backwards *subspinous*. *Luxatio erecta* is very rare, and results from forcible abduction of the arm; the arm is fixed in the erect position.

Signs.—(1) The shoulder is flattened, the acromion process prominent, and below it a hollow is present in place of the normal fulness. (2) The head of the bone is felt in some abnormal position. (3) The elbow is displaced from the side, and cannot be made to touch the body at the same time that the hand is placed on the opposite shoulder. (4) The axillary folds are lowered, and the vertical measurement around the axilla is increased. (5) A straight-edge can be made to touch the acromion process and the external condyle of the humerus at the same time. This, while not possible normally, is feasible in fracture of the anatomical neck of the humerus. Impaired mobility and bruising are present.

Special care should be taken to look for signs of nerve injury, which occurs in 10 per cent. of cases. Deltoid paralysis may result from injury to the circumflex nerve, posterior cord or outer trunk.

Treatment—(1) *Manipulation (Kocher's Method)*.—The arm is kept to the side, and with the elbow flexed to a right angle the forearm and arm are slowly and gently externally rotated to the fullest extent. The elbow is now brought forward through a right angle and adducted, the arm and forearm being then internally rotated.

(2) *Traction*.—This is seldom necessary and to be avoided when possible, owing to the risk of damaging structures in the axilla.

After reduction, the arm is bandaged to the side and a collar-and-cuff sling applied for a period of three weeks. Active exercises of shoulder and elbow are then started.

Dislocation of the shoulder may be overlooked for some time. Manipulative reduction can be

attempted up to six weeks from the time of injury. After this interval, operative reduction is advisable except in older patients, in whom the condition is best left untouched.

Recurrent Dislocation.—This is not uncommon, and causes considerable disability. It is always associated with laxity of the joint capsule and an abnormal range of external rotation. Defects of the glenoid cavity or the head of the humerus, weakness of the supraspinatus or infraspinatus, and contracture of pectoralis major, latissimus dorsi and teres minor may be contributory factors.

Treatment—1. *Clairmont's Operation.*—A muscle sling is made by detaching the posterior part of the deltoid muscle below, retaining its nerve supply, and bringing it through the quadrilateral space, when it is then sutured to the anterior portion of the same muscle in front.

2. *Nicola's Operation.*—The long tendon of the biceps is transplanted into a tunnel through the head of the humerus.

3. *Fascial Sling.*—The head of the humerus is slung from the acromion process by a strip of fascia lata passed through a tunnel in the humeral head.

II.—CAPSULE AND TENDON INJURIES.

The treatment of these is equal in importance to the treatment of the bone and joint injuries already described.

1. **Supraspinatus Tendinitis.**—During the middle range of abduction movement of the shoulder (60 to 120 degrees) there is friction of the supraspinatus tendon against the acromion process; this is minimized by the subdeltoid bursa, but in working men this bursa gradually becomes worn away and the constant trauma of the acromion process causes degeneration of the tendon and capsule. This makes the tendon susceptible to injury. The degeneration extends to the long head of the biceps and may also cause periarthrits and adhesion formation by the capsular tissues. Clinically there is pain in the

shoulder on abduction and localized tenderness over the greater tuberosity. Novocain injection relieves the pain, and it is said that this relief is often permanent, presumably from revascularization following hyperæmia. Short-wave diathermy and radiant heat therapy are useful adjuncts to stretching exercises.

In long-standing cases the degenerated tendon may become calcified; there is more pain than with simple tendinitis and X-rays reveal the calcified areas. The latter may require removal.

2. **Ruptured Supraspinatus Tendon.**—Although predisposed to by tendinitis, this is usually the result of a definite injury. The patient cannot abduct the shoulder fully, although passive abduction is normal. Treatment may be *conservative*—immobilization in abduction for eight to ten weeks or *operative* suture of the tendon to the greater tuberosity.

3. **Ruptured Biceps Tendon.**—The long head may undergo degenerative change in association with capsular degeneration, periarthrititis or osteoarthritis. It may rupture spontaneously or from a trivial muscular effort. There is a history of pain and stiffness of the shoulder. On supination or flexion of the forearm the belly of the muscle stands out in the lower part of the arm with a hollow above. If there is disability, the tendon may be stitched to the bicipital groove.

4. **Adhesions in and Around the Shoulder Joint.**—These may result from periarthrititis or may complicate fracture, dislocation or prolonged immobilization of the arm. Treatment is by graduated active exercises and gentle manipulation.

THE ARM

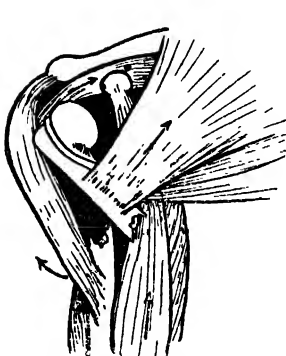
Fractured Shaft of Humerus.—The fracture may be spiral, oblique or horizontal. If just below the neck, the upper fragment is abducted by the supraspinatus; if below the pectoralis major insertion, this muscle adducts the upper fragment. Many fractures occur below the deltoid insertion, and this muscle abducts

the proximal end. Overlapping of the fragments is slight and displacement easily corrected.

Musculo-spiral paralysis may be due to contusion



(a) Above pectoralis major insertion.



(b) Between pectoralis major and deltoid insertions.



(c) Below deltoid insertion.

FIG. 12.—FRACTURED SHAFT OF HUMERUS.

of the nerve, in which case recovery ensues in six to eight weeks; other cases follow involvement in callus or scar tissue, and exploration is necessary.

Treatment.—A plaster slab applied from axilla to elbow and back to the point of the shoulder, combined with a collar-and-cuff sling for five to six weeks, suffices for spiral fractures. Horizontal fractures tend to unite more slowly, and an abduction frame should be used together with a plaster slab. If after six to eight weeks there is no union clinically, it is imperative that more thorough immobilization be employed. A plaster spica including shoulder and elbow should be applied until there is radiographic evidence of union. This may mean five to six months or longer. Once non-union is established, bone grafting is needed.

THE ELBOW

The elbow joint is very liable to injury, and off-repeated slight strains from passive stretching may lead to serious disability from adhesions and contraction. The same result will ensue if there is any irregularity or roughening of the articular surface when active movements are started.

1. Fractures of Articular Surfaces—(a) *Head of Radius*.—This is often associated with injury to the articular cartilage covering the capitellum. There is localized tenderness, effusion into the joint, limitation of extension, and pain on pronation or supination. If displacement is absent or minimal, a sling for two weeks suffices; but if the fragment projects into the joint cavity, or if the head is comminuted, early excision of the entire head is called for in adults. In children this is to be avoided, owing to the inevitable damage to the epiphyseal line.

(b) *Capitellum*.—(i) A small portion of articular cartilage, with or without bone, may be detached (chip fracture) and lie loose in the joint. It may not be detected by X-rays unless the joint is inflated with air. Removal is necessary. (ii) If the fragment involves a large part of the capitellum and adjacent trochlea, it must be replaced by manipulation or operation.

(c) *Olecranon*.—Fracture is due to sudden flexion

of the joint against the pull of the triceps. If the fibrous expansion of this muscle is untorn, there is little or no displacement, and firm union will be obtained by keeping the arm extended by an anterior plaster slab with firm strapping applied to approximate the fragments. In cases with marked displacement, fibrous union with weakness of extension will result unless operation is undertaken. In younger patients the fragments are approximated by catgut; whereas in older patients, in whom the fragments are often comminuted, excision of the proximal fragment should be followed by suture of the triceps expansion to the ulna, using strips of fascia lata or triceps tendon.

(d) *Coronoid Process*.—This is fractured in some cases of backward dislocation of the elbow. Treatment consists in keeping the joint flexed after reduction, with a posterior plaster slab.

2. Supracondylar and Condylar Fractures—(a) *Supracondylar*.—This is common in children and young adults. The line of fracture is oblique, in most cases running upwards and backwards and resulting in backward displacement of the lower fragment. Reduction is effected by manipulation, the elbow being pulled on and then flexed. A posterior plaster slab maintains this position. It is important to realize that in a few cases the line of fracture is downwards and backwards, and the lower fragment is then displaced forwards. Reduction is effected by traction followed by extension. (Fig. 13.)

Manipulation may have to be repeated more than once to achieve perfect reduction owing to the greatly-swollen elbow. An open reduction may even be necessary.

This type of fracture may be complicated by myositis ossificans (p. 197), Volkmann's ischæmic contracture (p. 167) or by injury to the main nerves.

(b) *Intercondylar (T- and Y-shaped)*.—These result from falls on the elbow and consist of a transverse supracondylar fracture with a vertical fracture running into the joint and separating the condyles. There is often comminution. Reduction by manipu-

lation presents great difficulties, and traction by transfixion or open operation with fixation by plates or wire is advocated. Stiffness of the elbow is liable to follow any form of treatment.

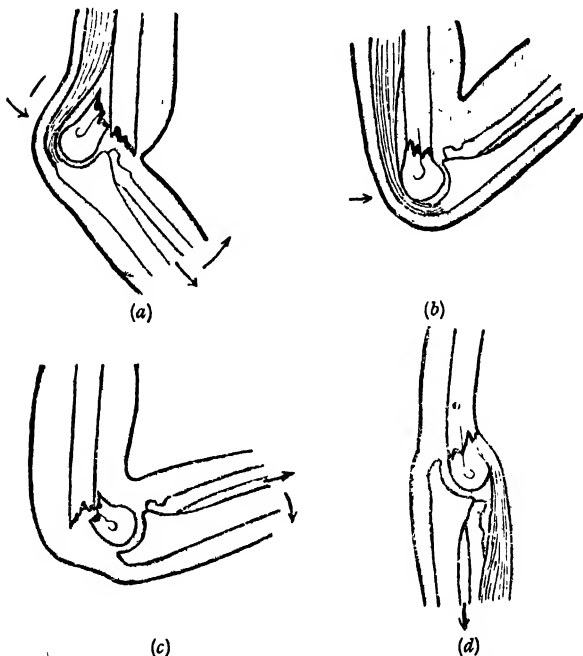


FIG. 13.—SUPRACONDYLAR FRACTURE OF HUMERUS.

(a) and (b) Backward displacement and method of reduction ;
 (c) and (d) forward displacement and method of reduction.

3. Epiphyseal Fractures (Separated Epiphyses)—

(a) *Lower Humeral Epiphysis*.—Fracture in this region is common in children and may easily be overlooked. The lower fragment is tilted forward,

and to correct displacement the elbow should be fully extended and kept thus for three weeks.

(b) *External Condyle Epiphysis*.—Fracture occurs between five and fifteen years. The broken fragment includes external condyle, capitellum, part of the trochlea, and the part of the shaft from which the extensors of the forearm arise. There may be lateral displacement only, and reduction can be brought about by manipulation. On the other hand, the fragment may be pulled outwards and rotated by the common extensors. If left in this position fibrous union must result, followed by cubitus valgus and delayed ulnar paralysis. Reduction by open operation is necessary, the fragment being fixed in position by catgut sutures.

(c) *Internal Epicondyle Epiphysis*.—This is a common injury in young people. If there is no associated tear of the internal lateral ligament of the elbow, displacement is slight and a collar-and-cuff sling is all that is needed. If the ligament is torn the fragment may be displaced into the joint or the elbow outwardly dislocated. In either event the ulnar nerve is bruised. Operative reduction allows reposition of the fragment and anterior transposition of the nerve prevents a late neuritis.

(d) *Upper Radial Epiphysis*.—This results from a fall on the outstretched hand, the head of the radius being forced against the capitellum. The fragment is displaced outwards and forwards and usually tilted so that the articular surface faces outwards. The essential point in treatment is the correction of this tilt, either by manipulation or open reduction. If not corrected, there is repeated trauma on movement and permanent limitation of extension follows.

4. *Dislocated Elbow*.—The forearm bones are displaced backwards, backwards and outwards or backwards and inwards. The insertion of brachialis anticus is torn or the coronoid process fractured. Reduction is easily effected and the joint is kept flexed with a collar-and-cuff sling and posterior plaster slab. Active exercises are encouraged after three weeks, but on no account should passive stretch-

ing be allowed, as this is very likely to lead to myositis ossificans.

Old unreduced dislocations may call for open reduction or arthroplasty if there is much ossification around the joint.

5. **Fracture-Dislocation**—(a) *Forward Dislocation with Fractured Olecranon*.—The fracture involves a large part of the olecranon. If, after reduction by manipulation, apposition is not close, open operation with suture of the fragments is called for. Union is slow, and it may be twelve to eighteen months before elbow movements are fully regained.

(b) *Dislocation with Fractured Head of Radius*.—After reduction of the dislocation the fracture is treated as laid down above (p. 214).

6. **Strains**—(a) *Traumatic Synovitis*.—The joint is swollen and tender, movement painful and limited. It should be rested by a collar-and-cuff sling and active exercises encouraged later. Passive stretching is to be avoided.

(b) *Tennis Elbow*.—This condition is not confined to tennis players, but also occurs in violin players, artisans and masseuses. It usually appears after prolonged and frequent pronation and supination with the elbow nearly extended. The patient complains of discomfort or pain to the outer side of the elbow and radiating down the forearm. There is localized tenderness in the region of the common extensor origin, but no signs of arthritis or joint injury. It is thought that the cause is a tear of the muscle fibres attached to the external epicondyle or a radio-humeral bursitis. Treatment is by manipulation or operation. The extensor muscles are stretched to the full, either by adducting the fully-extended elbow or by extending the joint while the forearm is held in pronation with the wrist and fingers acutely flexed. Active exercises are started at once. If operation is undertaken, the common extensor muscles are turned back from the humerus or divided in searching for a radio-humeral bursa and the condition is often relieved.

THE FOREARM

1. **Fractured Radius and Ulna.**—In addition to angulation there is usually marked rotation owing to muscle action. In fractures at the junction of upper and middle thirds of the radius the upper fragment is supinated by the biceps and supinator brevis, the lower is strongly pronated by pronator radii teres and pronator quadratus. When the fracture is at or below the middle third, the upper end is held in mid-pronation while the lower is fully pronated. Treatment is by manipulation and fixation by a plaster extending from the metacarpal heads to the axilla. The position of the forearm is dictated by the position of the upper fragment of the radius, and the lower fragment should be brought into line with it. Prolonged traction may be necessary before reduction is effected. Care must be taken to prevent redisplacement during application of the plaster and to see that it has not occurred later, as the swelling of the limb subsides. If so, a new plaster should be applied. The elbow is usually kept flexed, but in fractures near the upper end of the radius extension is preferable, as it prevents backward angulation.

In children, greenstick and crack fractures of radius and ulna are common and angulation can be easily corrected.

Union is slow in fractures at the junction of lower and middle thirds of the ulna owing to the poor blood supply of the distal fragment. Prolonged immobilization of both elbow and wrist is essential to prevent rotational strain and subsequent non-union.

Old unreduced fractures require open reduction combined if necessary with a bone graft or transfixion screw. Usually one bone only need be exposed, and if this is done cross-union or radio-ulnar synostosis is avoided.

2. **Fractured Ulna with Dislocated Head of Radius.**—The ulna is broken in the upper third. Backward angulation is present when the radial head is dislocated backwards, forward angulation when the head

has slipped forwards. Reduction is easy, by traction and pressure on the injured part. Immobilization should be prolonged, as union tends to be slow. In cases where the dislocation has been overlooked excision of the radial head may be needed.

3. Fractured Radius with Dislocated Lower End of Ulna.—The radius is broken at the junction of the lower and middle thirds and the capsule and fibro-cartilage of the inferior radio-ulnar joint are torn. The lower fragment of radius is pulled inwards and angulated. After reduction by manipulation there is a marked tendency to redisplacement while plaster is being applied. If this occurs, skin traction on the thumb may be tried by incorporating a metal hook in the next plaster. Skeletal transfixion of both forearm bones or open reduction with fixation by a screw or plate are alternatives.

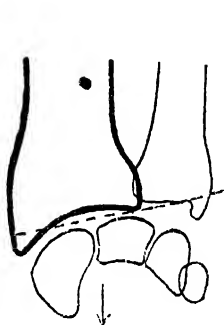
THE WRIST

Fractures occur in this region more frequently than in any other part and simple sprains are uncommon.

1. Fractures of Lower End of Radius—(a) Colles' Fracture.—The radius is broken about an inch above the wrist, and the lower fragment is displaced backwards and to the radial side. It is also tilted backwards, impacted and often comminuted. The internal ligament of the wrist is torn or the tip of the styloid process pulled off. A so-called 'dinner-fork' deformity is produced, the axis of the wrist joint is altered as seen by X-rays, and the styloid processes of radius and ulna are on the same level. If displacement is not reduced, the wrist will be permanently stiff, weak and unsightly.

Reduction by Manipulation.—(i) The fracture is disimpacted by strong traction on the hand. (ii) The lower fragment is gripped between the thenar eminence and fingers, and then tilted and pushed forwards and pronated. (iii) Pressure is then applied to the radial styloid process, pushing it towards the ulna.

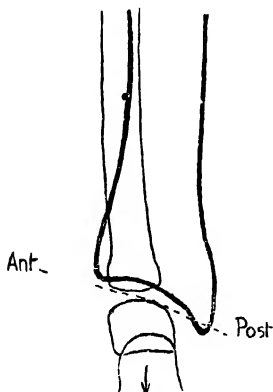
Immobilization.—An unpadded plaster cast is



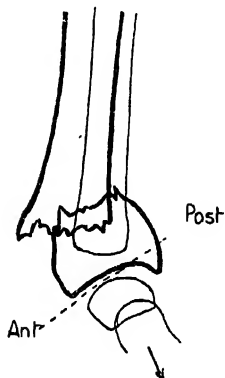
A.P. view of normal wrist.



Colles' fracture (A.P. view).



Lateral view of normal wrist.



Colles' fracture (lateral view).

FIG. 14.—COLLES' FRACTURE.

Note the alteration in the axis of the wrist joint.

applied from the metacarpal heads to just below the elbow, including the base of the thumb and the front of the wrist, but not including the palm. While the plaster is setting the wrist is firmly grasped and pulled inwards and forwards.

After-Treatment.—For two or three days the arm is supported by a sling, but active exercises of the fingers and shoulder should be commenced as soon as possible after reduction. The patient is encouraged to use the hand and arm in every way and to do light work. The plaster should be worn for five weeks.

(b) **Styloid Process.**—A crack or fissure through the base may follow from impaction of the scaphoid in falls on the hand or from starting-handle accidents. Less commonly avulsion may accompany a dislocated wrist. Any displacement must be corrected by manual pressure and a plaster applied for four to five weeks.

(c) **Posterior Marginal Fracture.**—A small portion of the lower end, including articular surface and the groove in which extensor pollicis longus runs, may be broken, as an isolated injury or part of a Colles' fracture. Unless the wrist is immobilized and thumb movements restricted for some weeks the tendon may become frayed and rupture. Where this has occurred, the distal end should be sutured to extensor carpi radialis longior or brevior.

(d) **Anterior Marginal Fracture.**—Forcible flexion of the wrist may rarely produce a fracture in which displacement is the reverse of Colles' fracture (Smith's fracture). In most cases a large anterior marginal fragment is carried forwards and there is subluxation of the wrist. Traction, followed by firm pressure, will bring about reduction.

(e) **Epiphyseal Fracture.**—The epiphysis and a small part of the metaphysis are displaced backwards or backwards and outwards, the internal lateral ligament of the wrist torn or a part of the ulna broken as in Colles' fracture. Treatment is as for Colles' fracture.

2. **Fractured Scaphoid.**—This is frequently overlooked. Skiagrams should be taken in three planes whenever there is swelling of the radial side of the

wrist and tenderness distal to the styloid process of the radius after a backfire injury or a fall on the hand. No fracture may be detected, but repeat X-rays are called for in three weeks if tenderness persists, and a crack may then be obvious. The fracture may (1) involve the *tubercle*, which is extra-articular; (2) run across the narrow *waist*; or (3) affect the *proximal pole*. The first type unites readily if the wrist is fixed for several weeks. Fractures of the waist usually join in six to eight weeks, but immobilization must be continued until there is radiographic evidence of union. Fractures of the proximal pole unite in the same period in over half the cases, but in the others union is delayed and immobilization

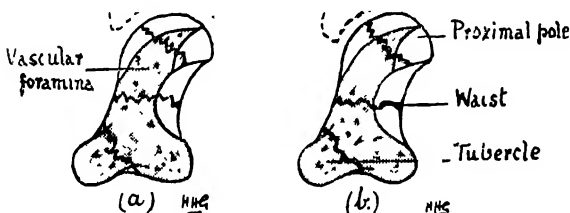


FIG. 15.—FRACTURES OF THE CARPAL SCAPHOID

Avascular necrosis of the proximal pole may occur in (b).

may need to be continued for as long as two years. Should avascular bone necrosis of the proximal fragment be detected by X-ray at the end of two months, operation is indicated. Both fragments of the scaphoid should be removed to prevent arthritis later.

If X-rays establish, by the dense sclerosis of the fragments, that non-union is present, an operation should be performed; the fragments may be drilled or a bone graft inserted.

3. Dislocated Semilunar.—This bone may be dislocated forwards by forcible dorsiflexion of the hand, the posterior ligament of the wrist being torn. It usually rotates on its anterior attachment so that the hollowed articular surface faces forwards. Re-

duction is brought about by traction on the hand, which is gradually flexed while pressure is exerted on the displaced bone.

If the case is first seen several weeks after the injury the bone should be removed. Open reduction is very liable to be followed by arthritis.

4. **Fracture-Dislocation of the Carpus.**—In some cases dislocation of the semilunar is accompanied by fracture of the scaphoid, part of which is also displaced. In others the semilunar bone remains in normal position, while some or all of the other carpal bones are dislocated. Treatment is reduction by manipulation.

5. **Soft Tissue Injuries**—(a) *Sprained Wrist.*—Great care must be taken to exclude bony injuries by repeated skiagrams before the diagnosis is made. The wrist should be supported by strapping or plaster for a week or two.

(b) *Traumatic Tenosynovitis.*—There is pain, tenderness, swelling and fine crepitus on movement of the affected tendon, usually one of the thumb extensors. Strapping or plaster suffices.

THE HAND

1. **Bennett's Fracture-Dislocation.**—The base of the thumb metacarpal is dislocated partially or completely from the trapezium, except for a small triangular fragment on the inner side which is broken off and remains *in situ*. Reduction is brought about by traction in slight abduction and must be maintained for at least four weeks. A wire frame is incorporated in a plaster extending from forearm to the base of the first phalanx and traction exerted by pulp transfixion.

2. **Fractured Metacarpals**—(a) *Base.*—These fractures may be impacted with some angulation which should be corrected. Fixation of the metacarpal region should be combined with active finger exercises.

(b) *Shaft.*—Spiral fractures occur in the third, fourth and fifth metacarpals and unite readily if the hand is strapped to a plaster cast. Transverse

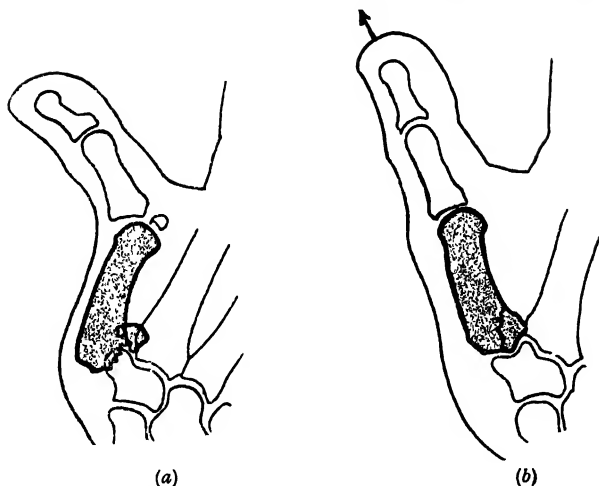


FIG. 16. BENNETT'S FRACTURE-DISLOCATION.
(a) Typical displacement ; (b) reduction by traction.

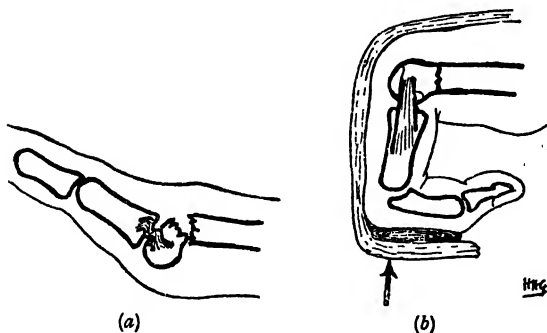


FIG. 17.—FRACTURED NECK OF METACARPAL.
(a) Typical displacement ; (b) reduction by flexion.

fractures may lead to backward angulation, which must be corrected and continuous traction applied.

(c) *Neck*.—Fracture of the fifth metacarpal neck is one of the common injuries of the hand. The head is tilted forwards, and to effect reduction the finger should be flexed to a right angle at the

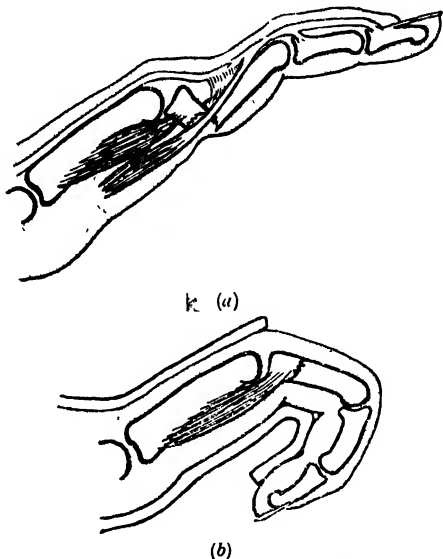


FIG. 18 —FRACTURED PHALANX.

(a) Forward angulation of fragments; (b) reduction by flexion.

metacarpo-phalangeal joint and pressed backwards. In this position the lateral ligaments are taut and maintain reduction. A plaster cast applied to the back of the forearm, hand and flexed finger maintains reduction.

3. **Fractured Phalanges.**—The proximal phalanx is the one usually broken and the fracture is near the

base. The fragments are angulated forwards owing to the pull of the lumbrical and interosseous muscles. The deformity is corrected by traction and flexion, and the correct position maintained by a plaster cast or a wire splint. The finger should be bent to a right angle at the proximal interphalangeal joint and flexed to 45 degrees at the metacarpo-phalangeal joint, the tip pointing to the tubercle of the scaphoid.

4. **Sprains and Dislocations**—(a) *Sprains* produce tenderness and swelling of the affected joint, and there may be an associated chip fracture of one of the bones. A simple sprain should be treated by firm strapping, but where there is a fracture the fragment must be replaced in position, if necessary by operation.

•(b) *Dislocations*.—In the metacarpo-phalangeal joints the thumb is most commonly affected, and the base of the phalanx is usually displaced backwards. In most cases reduction by traction is easy. If difficulty is experienced, it is due to the head of the metacarpal being nipped by the capsule and the interposition of the flexor tendon between the bones. Reduction is by open operation.

CHAPTER XIX

INJURIES OF THE LOWER LIMB

THE HIP

INJURIES of this region may be classified as follows: (1) Fractures of the neck of the femur; (2) dislocations of the hip; (3) epiphyseal injuries.

There are several recognized tests used in examination of cases of injury of the hip. **Nélaton's line** is drawn from the anterior superior iliac spine to the tuber ischii. The top of the great trochanter should touch this line if the limb is placed in the axis of the body. **Bryant's Triangle**.—With the patient in the supine position a vertical line is dropped to the bed from the anterior superior spine. Another line is

drawn from the anterior superior spine to the top of the great trochanter. The triangle is completed by a horizontal line from the top of the great trochanter to the vertical line. Any shortening is detected by comparing the length of the horizontal line with the corresponding line on the sound side.

1. Fractured Neck of Femur.—This usually occurs in elderly patients, sometimes from trivial injury. External rotation of the limb may be the only sign and the patient may be able to walk. Fractures of this part may be usefully divided into (a) *abduction* and (b) *adduction* fractures.

(a) **Abduction Fracture.**—Forcible abduction may produce a fracture at the junction of head and neck (*subcapital*) and the fragments are impacted on the outer side. Union occurs readily and the patient need only be kept in bed for a few weeks without splinting.

(b) **Adduction Fractures.**—There are three distinct types:

(1) *Subcapital.*—Hip movement is limited and painful, with forty-five degrees external rotation and $\frac{1}{2}$ to 1 inch shortening. The blood supply of the head is reduced and union is slow. Unless the fragments are securely fixed for some months there is constant shearing and the neck of the femur is gradually absorbed. Non-union results. The correct treatment to prevent this is operation and the insertion of a Smith-Petersen nail by the extra-articular route.

Technique.—(i) The nail is three-flanged and should be made of stainless steel or vitallium. (ii) It must be of correct length to fix the fragments securely and yet not penetrate into the joint cavity. (iii) It must be introduced accurately through the middle of the fragments. (iv) The nail is secured in position by some device such as Pidcock's cross-pin, which passes through the head of the nail into the shaft of the femur. (v) Knee exercises are commenced at once and the patient is allowed to sit up and encouraged to use the hip within a few days. Weight bearing is not permitted until there is some evidence of union.

An incision is made over the base of the great trochanter and a point chosen $\frac{1}{2}$ inch below the trochanter. A small portion ($\frac{1}{8}$ inch) of cortex is removed and a guide wire inserted with or without the help of some form of directing apparatus and its position checked by X-rays. The nail is hammered in over the guide wire, which is then withdrawn.

An alternative method of treating these fractures is in a plaster-of-Paris spica (Whitman's method). The fracture is reduced by abduction, internal rotation and extension, and a plaster applied. Bony union is obtained in about half the cases, but the prolonged immobility of the knee produces intractable stiffness.

(2) *Transcervical*.—The fracture line runs through the neck and the proximal fragment has a better blood supply than in subcapital fracture, and this promotes earlier union. Leadbetter's technique should be employed for reduction: the hip is flexed to a right angle and traction applied before the limb is internally rotated, abducted and extended. Fixation by a Smith-Petersen nail is employed.

(3) *Basal*.—The fracture line may involve the base of the neck (intertrochanteric) or run through the great trochanter (pertrochanteric). Both fragments are well supplied with blood, the fractured surface is wide, and there is impaction. There is ninety degrees rotation and 1 to 3 inches shortening. Union takes place readily *provided immobilization is adequate*. Fixation in abduction by plaster of Paris for four or more months will suffice, but has disadvantages (see above). Provided there is not much comminution a Smith-Petersen nail may be employed.

Ununited Fractures.—The treatment of these depends upon the amount of absorption of the neck and on whether the upper fragment is alive or dead. In all cases the first object is to bring about abduction of the shaft of the femur so that weight bearing will produce impaction instead of a shearing stress. A simple subtrochanteric abduction osteotomy suffices in cases of delayed union. In cases of non-union with slight absorption of the neck and a live head,

a Smith-Petersen nail may be employed after the fragments have been drilled freely. When the neck is absorbed and the head dead some form of reconstruction operation is indicated. Lorenz bifurcation osteotomy is favoured by some, Whitman's operation by others; in the latter the head of the femur is removed, the trochanter transplanted lower down the shaft, and the neck fitted into the acetabulum.

2. Dislocated Hip.—This is more common than is usually supposed. The head of the femur is driven through the weakest part of the capsule, which is below and behind. The hip is usually flexed at the time of injury, frequently adducted as well, but sometimes abducted. The femoral head may travel backwards (*posterior dislocation*) on to the dorsum ilii (dorsal type) or on to the sciatic notch (sciatic type). The limb is adducted, shortened and internally rotated. If the head moves forwards (*anterior dislocation*) it may lie on the horizontal pubic ramus (pubic type) or on the obturator foramen (obturator type). In *central or intrapelvic dislocation* the head is forced into the pelvis and the acetabulum may be comminuted or a large fragment displaced inwards.

Complications.—(1) Marginal fracture of the acetabulum is frequent, and if a large fragment is broken off reduction tends to be unstable. (2) Avascular necrosis of the femoral head is said to occur in 25 per cent. of cases. (3) Sciatic paralysis may occur in posterior dislocations. (4) Myositis ossificans.

Treatment—(1) *Reduction by Manipulation.*—The patient is anæsthetized lying on the floor and the pelvis steadied by an assistant. The hip and knee are flexed to a right angle. The limb is then rotated gently and slowly into the normal position and strong traction applied.

(2) *Immobilization.*—Simple dislocations need a plaster spica for two months. When there is a fracture of the acetabulum, traction for at least one month in an abduction frame is advisable.

3. Epiphyseal Fractures—(a) **Upper Femoral Epiphysis.**—Injury is one of the factors responsible for the backward and downward displacement occurring

in children between the ages of ten and nineteen (*adolescent coxa vara*). There may or may not be a history of a trivial twist or strain. Pituitary dysfunction is another factor.

Pain in the hip or knee and a limp are usually the main symptoms. The child is often obese and the foot is everted. Hip movements are limited, particularly abduction and internal rotation.

Diagnosis.—In the early stage skiagrams must be taken in the lateral plane, and minor displacements will be evident. Later, it will be seen that the head is still in the acetabulum, while the neck has risen and is adducted and externally rotated.

Treatment.—(1) Early cases can be reduced by skin or skeletal traction within a week or two. Light traction must be continued until the epiphysis has united as shown by X-rays. Fusion of the epiphysis may be brought about by drilling, bone graft or a Smith-Petersen nail.

(2) If necrosis of the epiphysis has occurred, prolonged traction and avoidance of weight-bearing should be tried, but arthrodesis will probably be needed later.

(3) If reduction cannot be effected by traction, subtrochanteric osteotomy gives good functional results.

Reduction by forcible manipulation or open operation is to be condemned in all cases, as necrosis of the epiphysis will thereby be precipitated.

(b) **Lesser Trochanter Epiphysis.**—This may be avulsed by the ilio-psoas muscle. Displacement is slight and union occurs if the hip is kept flexed for four weeks.

(c) **Great Trochanter Epiphysis.**—Avulsion is due to the pull of the glutei and external rotators of the hip. Fixation in abduction for six weeks in a plaster spica is the treatment.

THE THIGH

1. **Subtrochanteric Fracture of Femur.**—The upper fragment is abducted by the gluteal muscles and the shaft is adducted by the adductors of the thigh. The

line of fracture may run downwards and inwards or upwards and inwards.

Treatment.—The essential point is to bring the shaft into accurate alignment with the upper fragment by abduction of the limb. A plaster spica, which must include both hips, will provide adequate fixation in some cases, but where the fracture line runs upwards and inwards it must be combined with traction applied through adhesive strapping under the plaster. An alternative method is a Robert Jones' abduction frame.

In fractures just below the lesser trochanter, the upper fragment is flexed as well as abducted and treatment presents special difficulty. It may be necessary to employ well-leg traction so that the patient can be treated sitting up in bed.

2. Fractured Shaft of Femur.—The powerful thigh muscles produce considerable overlapping and angulation, while external rotation of the lower fragment results from gravity.

Treatment—(a) *Skin Traction.*—Adhesive strapping is employed to fix the limb to a Thomas's knee splint or a Hodgen's splint. The foot of the bed is raised and the splint suspended from a Balkan frame. Backward sagging of the fragments and lateral displacement must be corrected by separate traction bands locally.

In children up to ten to twelve years good results follow the gallows method of Bryant. Both legs are slung by strapping to an overhead beam, with the buttocks raised off the bed.

(b) *Skeletal Traction.*—A transfixion pin or Kirschner wire may be used for transfixion of the femur just above the adductor tubercle or of the tibia at the level of the tibial tubercle. A Braun's splint or a Thomas's knee splint with a hinge and movable leg piece is employed with an initial weight of 20 to 30 pounds.

Supracondylar skeletal traction avoids pressure sores and enables early active exercises of the knee joint. On the other hand, low-grade infection of the transfixion track may result in adhesions and permanent stiffness.

(c) *Open Operation*.—This is occasionally required for unreduced or malunited fractures, the fragments being plated.

After-Treatment.—Union is usually firm in eight to ten weeks and traction is then discontinued. The patient is allowed up with a Thomas's walking calliper. Active exercises of all joints, particularly the knee, should be encouraged, and the foot and leg should be firmly bandaged to prevent gravitational oedema.

3. **Supracondylar Fracture**.—The lower fragment is angulated backwards by the gastrocnemius, and to

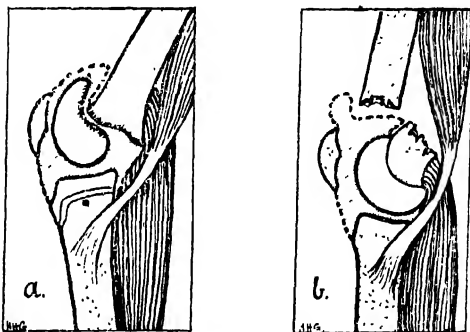


FIG. 19.—FRACTURES OF LOWER END OF FEMUR.

(a) Epiphyseal fracture ; (b) supracondylar fracture.

obtain accurate reduction the knee must be flexed to 45 degrees and the lower thigh pressed forwards. A Böhler-Braun splint, with skeletal traction through the tibial tubercle, provides effective treatment.

4. **Epiphyseal Fracture**.—Usually the epiphysis is displaced forwards, but it is also tilted backwards by the gastrocnemius. The popliteal vessels are stretched over the lower end of the shaft and bruised. Ischæmic contracture may follow. Compression of the vessels may lead to thrombosis and gangrene.

Treatment.—The knee should be flexed to a right angle and traction applied to the leg. Direct backward pressure on the epiphysis may also help. After reduction an anterior plaster slab is applied to maintain the knee at 90 degrees flexion or more if reduction is unstable.

THE KNEE

The knee-joint is particularly liable to injury owing to its exposed position and the fact that it depends for its stability upon the muscles which move it. Weakness of the quadriceps predisposes to injury. Injuries can be classified under three headings: (1) Internal derangements; (2) capsular injuries; (3) fractures.

1. Internal Derangements—(a) **Torn Semilunar Cartilage.**—This results from sudden twists of the knee when flexed and abducted. It occurs in miners working in the pits, in footballers and hockey players. Either the internal or external cartilage may be torn, the former more frequently. The tear may involve: (i) anterior or posterior horn, or both; (ii) attachments to the internal lateral ligament, or to the edge of the tibia (*coronary ligaments*); (iii) the cartilage itself, in which case the tear may be transverse or longitudinal (*bucket-handle type*). A portion of the cartilage may become displaced and fixed between the joint surfaces, effusion into the joint resulting. Healing of the cartilage is always poor, and there is liability to recurrence of displacement.

Signs and Symptoms.—Severe pain in the knee, which may become locked in the flexed position, followed by an effusion into the joint and tenderness over the injured cartilage. If untreated, the joint is liable to recurrent attacks of pain and synovitis.

Treatment—(1) **Reduction.**—Full flexion and external rotation of the knee are followed by internal rotation and extension. An anæsthetic is desirable.

(2) **Immobilization.**—Rest, massage and electrical treatment to the quadriceps for several weeks should

be followed by firm bandaging of the knee for one to two months and active exercises.

(3) *Operation* is necessary for all recurrent cases. The torn cartilage and any hypertrophied synovial fringes should be removed.

(4) *Apparatus*.—If operation is refused, a kneecage which prevents full extension must be worn constantly.

(b) *Semilunar Cartilage Cysts*.—These generally occur on the outer convex border of the external cartilage, and are usually multilocular. A tense, fluctuating swelling appears on the outer side of the knee and the patient gives a history of injury. Treatment is by removal of the whole cartilage.

(c) *Rupture of Cruciate Ligaments*.—Results from severe injuries, and may be accompanied by fracture of the tibial spine. When the anterior cruciate is torn the tibia can be displaced forwards with the knee extended; it can be displaced backwards with the knee flexed when the posterior cruciate is involved. Pain and effusion into the joint are considerable, and permanent weakness results.

Treatment.—The knee should be immobilized in extension in plaster for at least two months, followed by a cage splint hinged at the knee. Quadriceps exercises should be encouraged and a stable joint will probably result. Fashioning of new ligaments from fascia lata is of doubtful value, as they tend to stretch.

(d) *Fractured Tibial Spine*.—Avulsion of the spine or its medial tubercle is produced in the same way as rupture of the anterior cruciate ligament. The displaced fragment prevents full extension. Replacement should be attempted by extension of the joint under anæsthesia or by open operation, and the knee immobilized in plaster for six weeks.

(e) *Injury to Infrapatellar Pad*.—Hæmorrhage into this fatty structure is followed by thickening, which exposes it to further injury during movements of the joint; the synovial membrane covering the pad becomes hypertrophied and is liable to be nipped, producing recurrent attacks of pain and effusion. The

pain is most marked on extension of the joint, and referred to the sides of the patellar ligament. Locking does not occur.

(f) **Loose Bodies.**—These may consist of organized fibrin, portions of articular or semilunar cartilage, or of bone. They give rise to sudden pain and locking of the joint, followed by effusion. The site of the pain varies and the loose body may be palpated.

(g) **Traumatic Synovitis.**—Trauma may result in a simple or blood-stained effusion into the joint. The hollows at the side of the patella are obliterated, the suprapatellar pouch distended, and a patellar tap can be elicited. Firm pressure should be applied by a crêpe bandage, the knee immobilized for one to two weeks, and quadriceps exercises encouraged.

Recurrent synovitis is common in middle-aged patients with osteo-arthritis and is predisposed to by wasting of the quadriceps. The essential part of the treatment is re-education of this muscle, and weight bearing should be reduced to a minimum until the effusion has been absorbed.

2. **Capsular Injuries**—(a) **Internal Lateral Ligament.**—Sprains are due to forcible abduction of the knee while extended. Bruising, swelling and tenderness are present at the site, and pain on attempted abduction. A firm crêpe bandage, quadriceps exercises, and a $\frac{1}{4}$ inch wedge on the inner side of the shoe will bring about recovery in a few weeks.

Rupture or avulsion of the ligament allows undue lateral mobility, and the knee must be immobilized in plaster for at least two months, quadriceps exercises being encouraged all the time. In neglected cases the knee is unstable, and it may be advisable to construct a new ligament from the semitendinosus or from fascia lata.

(b) **External Lateral Ligament.**—Adduction strains produce injuries similar to those described above, but are less frequent. The styloid process of the fibula may be avulsed and open operation is needed to replace and suture it into position.

(c) **Avulsion of the Quadriceps.**—In elderly patients the quadriceps may be torn from the patella in at-

tempting to avoid a fall. The patient cannot extend the knee and there is tenderness at the upper border of the patella. The muscle should be carefully sutured, otherwise ossification will take place in the hæmatoma (*myositis ossificans of the quadriceps*).

(d) **Avulsion of Ligamentum Patellæ.**—This may occur in young patients from sudden contraction of the quadriceps. The power of extension is lost and the patella retracted upwards. Suture is called for.

(e) **Dislocated Patella.**—The displacement is usually outwards, the result of a blow or kick, or less commonly of muscular action. As a rule it occurs in young girls with genu valgum, a loose capsule and a poorly-developed external femoral condyle. Reduction is simple and may even take place spontaneously. The knee should be immobilized for two months.

Recurrent Dislocation.—This may be of the *congenital*, *rachitic* (associated with knock-knee) or *traumatic* type. Conservative treatment may be tried, quadriceps exercises being combined with a knee cage, the heel being raised on the inner side. Various operations may be called for: (1) Supracondylar osteotomy for genu valgum; (2) transplantation of the tibial tubercle to the antero-medial aspect of the tibia; (3) Krogus' operation. A strip of lax capsule on the inner side is transposed across the patella to the outer side, forming a bridge or pier graft.

(f) **Dislocated Knee.**—The tibia may be displaced forwards, backwards, or laterally. The popliteal vessels or external popliteal nerve may be injured. Reduction is by traction and the knee should be immobilized for three months in plaster.

3. **Fractures** — (a) **Patella.** — This is commonly broken by muscular violence producing a transverse fracture, less often by a direct blow causing a stellate fracture.

(1) *Transverse Fracture.*—The quadriceps aponeurosis and capsule on either side of the patella are torn and the fragments are separated. The lower fragment is tilted forwards and the fractured surface covered by aponeurosis. Unless operation is under-

taken, fibrous union with lengthening of the tendon and limitation of active extension results.

Treatment.—The joint is exposed, blood clot washed out, and the fractured surfaces cleared of aponeurosis. The fragments are accurately approximated by catgut, fascia lata or silk, passed through horizontal drill holes or encircling the patella. The quadriceps aponeurosis is also sutured with care. A plaster cast is worn for two months, but weight bearing may be allowed within a week of operation.

(2) *Stellate Fracture.*—The patella is comminuted, but the aponeurosis is untorn and the fragments are not widely separated. As a rule a posterior plaster slab suffices and weight bearing may be allowed.

After both transverse and stellate fractures the articular surface of the patella may be irregular and roughened. Osteo-arthritis is liable to follow, and this fact has led to the belief that fractures of this bone are best treated by excision of the fragments and careful suture of the aponeurosis.

(b) *Tibial Tubercle.*—Fracture is rare in adults and displacement minimal, as the aponeurosis is intact. Avulsion of the epiphysis is more frequent and may occur up to the age of eighteen years. The tibial tubercle may ossify from a separate centre or as a part of the upper tibial epiphysis. In the former case displacement may be marked and operative reduction and suture is called for; in the latter manipulation usually secures reduction.

(c) *Tibial Tuberosity.*—The external tuberosity is the one usually fractured by a severe blow on the outer side of the extended knee. Forcible abduction tears the capsule and the femoral condyle is driven against the tibia. Two types of fracture must be recognized:

(1) *Depressed.*—The fracture line runs from the non-articular region of the tibial spine towards the head of the fibula. The whole tuberosity is depressed and impacted and the cruciate ligaments may be undamaged. The displacement can be corrected by traction and manipulation, and if the knee is

immobilized until union is sound, in a matter of two to three months, the outlook is good provided quadriceps exercises have been faithfully carried out.

(2) *Comminuted*.—A large marginal fragment is displaced outwards and tilted, but in addition the articular surface of the tuberosity is comminuted. The cruciate ligaments are torn, the external semilunar cartilage displaced into the head of the tibia, and some of the fragments are deprived of their blood supply. Degenerative arthritis and an unstable joint may result. Treatment should be by

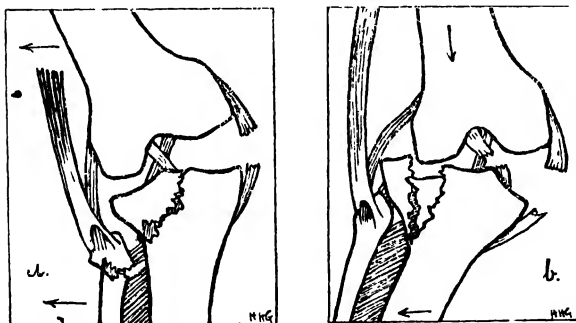


FIG. 20.—FRACTURES OF TIBIAL TUBEROSITY.

(a) Depressed; (b) comminuted.

strong traction with lateral pressure on the tuberosity by a special clamp. The knee should be fixed in plaster for three months and a guarded prognosis given.

(d) *Tibial Spine*.—Fracture of this is described on p. 235.

THE LEG

1. **Fractured Tibia and Fibula**.—Both bones are frequently broken and the incidence of compound fractures is high owing to the superficial position of the tibia. In many cases the line of fracture is oblique

or spiral and there is considerable swelling of the leg, both factors predisposing to redisplacement after reduction unless traction is maintained. The lower half of the tibia has a poor blood supply and union may be delayed.

Treatment—(a) Reduction.—Traction must first be applied, a Watson-Jones apparatus providing an effective method.

A transfixion pin is inserted through the tibia

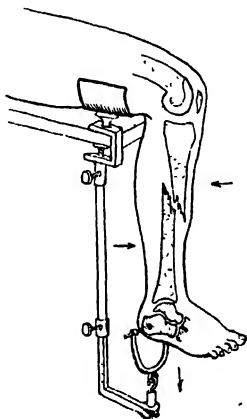


FIG. 21.—WATSON-JONES'S TIBIA TRACTION APPARATUS.

1 inch above the ankle or through the os calcis, care being taken to see that the axis is such that patella and big toe point in the same direction when traction is applied. The leg is now lengthened by adjusting the apparatus attached to the stirrup and firm lateral manual pressure is applied to the fragments. Radiograms are taken in two planes.

(b) Immobilization.—A plaster cast is applied over a thin layer of wool from the metatarsal heads to below the knee, while manual pressure is maintained at the site of the fracture. As soon as the plaster is set the knee is straightened to 45 degrees short of

full extension and the plaster continued to the mid-thigh.

(c) *Traction*.—As a rule this should be maintained for three to six weeks. The limb is supported on a Braun splint and 10 to 15 pounds pull exerted.

(d) *Changing of Plaster*.—This is necessary when there was considerable swelling at the time of reduction. When swelling has subsided an unpadded plaster is applied with the knee slightly bent and the transfixion pin is removed.

(e) *Test of Union*.—After eight to twelve weeks, if radiograms show callus between the fragments, the plaster is removed. If union is sound there is no tenderness, no pain on straining the leg, and no 'springing' of the fracture. Another plaster is applied if these signs are present and the patient allowed to walk. The process is repeated every six weeks until union is sound.

Non-Union.—This is usually the result of inadequate immobilization. The bone ends should be cleared of sclerosed tissue and a bone graft inserted. Careful fixation in plaster will usually result in union.

2. **Fractured Tibia**.—Greenstick and fissured fractures are more frequent in children and produce slight angulation, which is easily corrected. Union is usually firm in six to eight weeks if a plaster cast is applied.

3. **Fractured Fibula**.—The shaft may be broken alone by direct violence, but in many cases there is an associated injury to the knee or ankle joint. Simple fractures unite readily.

THE ANKLE

This region is very subject to injury, usually as the result of sudden inversion or eversion of the foot from tripping on an irregular surface. Injuries may be divided into (1) bony injuries, (2) capsular injuries.

1. **Bony Injuries** — (a) **Abduction Fracture and Fracture-Dislocation**.—Forcible abduction or external rotation of the foot may cause: (1) Fracture of

the external malleolus or the shaft of the fibula without displacement of the astragalus; (2) outward dislocation of the astragalus as well as fracture of the fibula, the internal lateral ligament of the ankle being torn or the tip of the internal malleolus being broken; (3) in addition there may be a posterior marginal fracture of the tibia with outward and backward dislocation of the astragalus. If there is displacement and fracture the term *Pott's fracture* is often used to describe this injury, and if, in addition,

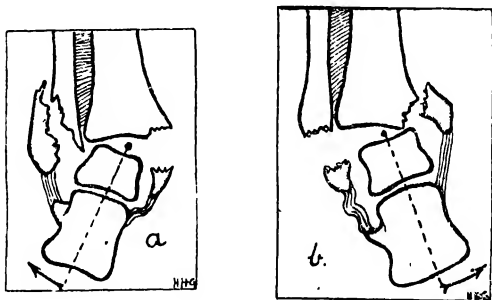


FIG. 22.—FRACTURE-DISLOCATIONS OF THE ANKLE.

(a) Abduction fracture-dislocation; (b) adduction fracture-dislocation.

the interosseous ligament is torn and the tibia and fibula separated it is called *Dupuytren's fracture*.

Treatment.—(1) Fracture of the external malleolus should be treated by a walking plaster or firm strapping of the ankle for a few weeks.

(2) Outward dislocation of the astragalus must be completely reduced by firm pressure inwards and a plaster applied from toes to just below the knee. Immobilization is continued for ten to twelve weeks, but the patient is encouraged to walk during this time.

(3) Outward and backward dislocation of the astragalus can be reduced by strong pressure forwards and inwards while the knee is kept flexed to relax

the tendo Achillis. Great care is needed to ensure that redisplacement does not take place while a plaster is being applied or at a later date as the swelling of the limb subsides.

(b) Adduction Fracture and Fracture-Dislocation.—

Forcible inversion or adduction of the foot may force the astragalus inwards and cause (1) fracture of the internal malleolus alone; (2) inward dislocation of the astragalus as well, the external lateral ligament being torn or the tip of the external malleolus being avulsed; (3) inward and backward dislocation of the astragalus with a posterior marginal fracture of the tibia.

The treatment of these injuries is dictated by the same principles as laid down for abduction fractures and fracture-dislocations.

(c) Vertical Compression Fracture-Dislocation.—A fall from a height may force the foot upwards and forwards, resulting in an anterior marginal fracture of the tibia with forward or central dislocation of the astragalus; in the latter instance the interosseous tibio-fibular ligament is torn and the bones separated. There is considerable swelling of the ankle and reduction tends to be very unstable. Skeletal traction is often needed, a transfixion pin through the os calcis being incorporated in the plaster and 10 pounds weight employed for six weeks.

Malunited Fracture-Dislocations.—Serious disability will result from valgus deformity and from painful stiffness if the dislocation is not completely reduced; later osteo-arthritis of the ankle may supervene. Osteotomy of the tibia may relieve the valgus, but painful stiffness is best treated by arthrodesis; stripping of articular cartilage may be combined with a bone graft between tibia and astragalus.

In adduction fractures fibrous union of the internal malleolus may cause persistent pain and weakness of the ankle. It is due to interposition of periosteum between the fragments and may be avoided by operation. At an early stage the fragments should be cleared, in later cases drilled and fixed by a nail or graft.

(d) **Epiphyseal Fracture of Tibia.**—The lower tibial epiphysis, together with a large triangular portion of metaphysis on the posterior aspect, may be displaced backwards and outwards by abduction or eversion strains. Reduction is simple and a walking plaster for two months suffices. Adduction or inversion strain may crush the inner side of the epiphysis and cause premature fusion.

2. **Capsular Injuries.**—(a) **Sprains.**—The external lateral ligament may be torn by unexpected inversion of the foot. Swelling, bruising and tenderness are present, together with pain on inversion. The ankle joint shows no lateral instability or abnormal mobility of the astragalus. The ankle should be strapped with 'elastoplast' or adhesive strapping for one to two weeks and the patient allowed to walk. The principles governing sprains of the internal lateral ligament are similar.

(b) **Dislocation or Subluxation.**—This is more frequent than usually supposed, as spontaneous reduction often takes place, and the case is diagnosed as a bad sprain. Both the anterior and middle portions of the external lateral ligament are completely torn from the malleolus and there is considerable bruising and swelling. If the foot is strongly inverted after novocain injection, the astragalus may be felt to tilt and a groove may be seen below the external malleolus. The foot should be X-rayed in this position and the tilting will be apparent on the radiogram. The ankle should be immobilized in plaster for ten weeks and the patient allowed to walk.

Recurrent dislocation is the result of failure to diagnose and deal adequately with a recent dislocation. The ankle is permanently weak and gives way easily. The diagnosis is made on strong inversion and X-ray examination confirms it. The treatment lies in operation. A new external lateral ligament is fashioned from the peroneus brevis (Watson-Jones) or from fascia lata.

THE FOOT

I. Fractured Os Calcis.—This results from a fall from a height on to the feet and bilateral injury is not uncommon. Fracture of the spine may be an associated injury. The heel is tender and broadened, inversion and eversion are painful, but ankle movements may be normal. Many varieties of fracture are described and may be usefully considered under three headings:

(1) **Fractures without Displacement of Articular Surfaces**—(a) *Vertical Fracture of the Tuberosity.*—Any displacement should be reduced by compression with an os calcis clamp to avoid spur formation and a walking plaster employed for six weeks.

(b) *Horizontal or Beak Fracture of Tuberosity.*—This involves usually the upper third of the tuberosity, above the tendo Achillis insertion. The foot should be plantar flexed, manual pressure applied to the fragment and a walking plaster used for six weeks.

(c) *Avulsion of the Tuberosity.*—The tendo Achillis pulls an oval fragment upwards. Operation is needed to suture the fragment in position.

(d) *Fracture of Sustentaculum Tali.*—Compression reduces any displacement and a walking plaster for six weeks suffices.

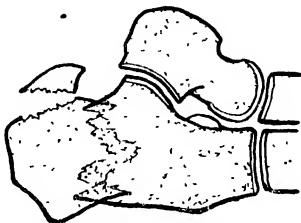
(e) *Comminuted Fracture.*—If the articular surface is not crushed a walking plaster for six weeks is enough.

(2) **Fractures with Displacement of Articular Surfaces.**—Forty per cent. of os calcis fractures result in widening of the tuberosity and its displacement upwards. The displaced fragment carries with it the outer half of the articular surface of the posterior subastragaloid joint.

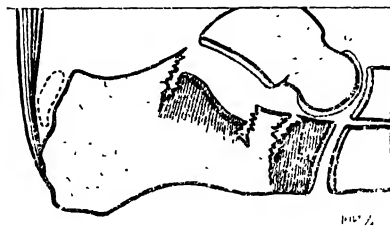
Treatment.—Reduction should be deferred for some days until swelling has subsided. A transfixion pin is inserted through the posterior superior angle of the os calcis just in front of the tendo Achillis and longitudinal traction applied. Lateral compression of the bone is now carried out by Böhler's com-

pression clamp. A plaster is then put on from the toes to the tibial tubercle. Traction of 10 pounds weight must be continued for three months as union is slow. The plaster is then removed and active exercises encouraged. Manipulation of the foot is needed if pain persists.

Some authorities prefer to exert traction in a downward and backward direction, and a second



(a) Without displacement of articular surface.



(b) With displacement of articular surface.

FIG. 23.—FRACTURES OF OS CALCIS.

transfixion pin is inserted through the tibia 2 to 3 inches above the ankle to maintain counter-traction in a forward direction.

(3) **Fractures with Displacement and Avascular Necrosis of Articular Surfaces.**—In these the articular surface is crushed and parts of the bone are deprived of blood supply. If the case is not operated upon, fibrous ankylosis of the subastragaloid joint and a

painful stiff foot result. Arthrodesis of the subastragaloid joint and of the mid-tarsal joint is called for. It may be carried out a week or two after injury, and a transfixion pin is inserted through the os calcis at the same time. A plaster is applied and traction kept up for three months. This ensures rectification of the tuber-joint angle and overcomes slackening of the tendo Achillis.

2. **Fractured Astragalus.**—As an isolated injury this is rare. The neck or the posterior process may be broken, but displacement is slight and a walking plaster suffices. More often fractured astragalus is part of a subastragaloid dislocation.

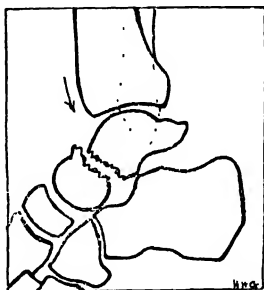


FIG. 24.—SUBASTRAGALOID FRACTURE—DISLOCATION.

3. **Dislocated Astragalus.**—Forward is more frequent than backward dislocation and may be complete. Reduction should be attempted by manipulation with the foot in plantar flexion, with traction applied. If this fails, the astragalus should be removed, a useful foot resulting.

4. **Subastragaloid Fracture-Dislocation.**—The astragalus is fractured through its neck, and while the body lies in normal position, the head and all the rest of the tarsal bones are usually displaced forwards and inwards, sometimes forwards and outwards. Reduction is brought about by full *plantar flexion*, eversion and abduction. This position must be main-

tained for eight weeks or more in a walking plaster. Avascular necrosis of the astragalus body may follow operative reduction or from failure to secure reduction, and the result will be degenerative arthritis. It is better to anticipate this by removal of the astragalus.

5. **Subastragaloid Mid-Tarsal Dislocation.**—The astragalus is in the normal position, the rest of the tarsus dislocated inwards. Early reduction is called for to avoid sloughing of the skin. The foot should be abducted and everted and a walking plaster used for six weeks.

6. **Fractured Scaphoid.**—The tuberosity may be broken by the pull of the tibialis posticus, displacement is slight and union occurs readily. Crush fracture with displacement of fragments upwards may be caused by a fall from a height. Reduction by manipulation, and a walking plaster, usually suffices.

7. **Fractured Metatarsals.**—The base of the fifth metatarsal may be avulsed by the peroneus brevis or broken by forcible inversion of the foot. One or more metatarsal necks may be broken and the heads displaced towards the sole; displacement must be reduced by pulp traction on the toes.

8. **Fractured Phalanges.**—If there is angulation, the displacement can be reduced by flexion as in the hand (see p. 226).

CHAPTER XX

INJURIES OF THE SPINE AND PELVIS

THE SPINE

THE usual sites of injury of the vertebral column are at the junction of the mobile and less mobile segments, and it is therefore useful to consider injuries to the *dorso-lumbar* and *cervical* regions separately. Injuries complicated by paraplegia will be considered in a later section.

I. **Dorso-Lumbar Injuries**—I. **Fracture of Vertebral Body.**—In practically all cases forcible flexion is

responsible. Three types are recognized: (a) *simple wedge* or *compression* fracture, which embraces 60 per cent. of vertebral body injuries, usually involves several vertebræ: it is due to falls from a height in the standing or sitting position; (b) *comminuted* fracture is due to angulation of the spine from a weight falling on the bent back, one vertebra being crushed in front; (c) *fracture-dislocation*, the upper part of the spine being displaced forwards: the neural arch is fractured or the interarticular joints

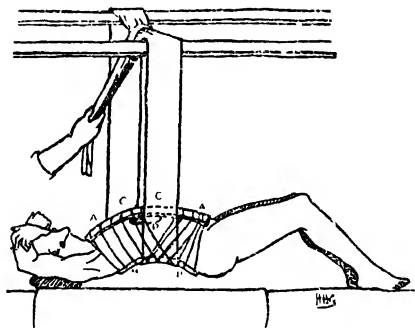


FIG. 25.—METHOD OF OBTAINING HYPEREXTENSION IN FRACTURED SPINE (GREENWOOD'S).

dislocated, and thus there is often associated injury to the spinal cord or nerves.

The diagnosis is made by finding one spinous process prominent on inspection and palpation, and is confirmed by a lateral radiogram.

Treatment.—Hyperextension of the spine to secure reduction followed by immobilization in plaster for four to six months are the essentials. Active exercises are encouraged during this period. Many methods are described for obtaining hyperextension. One of the most practical, applicable to all cases, is Greenwood's method. The patient is suspended in the supine position from a double Balkan frame by a broad double

band of domette opposite the site of the fracture. By this band the body is raised until buttocks and shoulders are clear of the table. A plaster jacket is then applied incorporating anterior and posterior slabs. When these have set firmly the sling is cut and the plaster completed. The plaster jacket must extend from the symphysis pubis to the top of the sternum.

Compression fractures may be overlooked for several weeks. Manipulative reduction while the prone patient is suspended by the feet (Davis's technique) is advisable.

N.B.—There is a small group of vertebral body fractures which must not be hyperextended:

(a) *Fracture-Dislocation with Locked Articular Processes.*—The upper spinal segment has been displaced laterally or rotated. Hyperextension would angulate the spine and stretch the spinal cord. Operation is therefore called for to bring about reduction, and it may be necessary to excise one of the articular processes.

(b) *Hyperextension Fractures.*—A plaster jacket is applied with the patient sitting upright.

(c) *Comminuted Fracture with Backward Displacement.*—Fragments may encroach on the neural canal and hyperextension would increase pressure on the spinal cord. A plaster jacket is applied while the patient sits upright with head traction.

2. Fractured Transverse Process.—The lumbar region is usually affected. One or more processes may be avulsed by sudden contraction of the quadratus lumborum or broken by a crush injury. Pain and tenderness in the lumbar region are increased on attempted lateral movements of the spine. Treatment is by strapping and rest when there is a simple crack without displacement, by a plaster jacket for six to eight weeks in more severe cases. Union often occurs by fibrous tissue.

3. Fractured Spinous Process.—One spinous process, usually the seventh cervical or first dorsal, may be avulsed during heavy manual work, or broken by direct violence. Fixation is unnecessary.

II. Cervical Injuries.—In this region dislocation and fracture-dislocation are more common than simple fracture.

1. **Interarticular Joint Injuries**—(a) *Sprains* are due to sudden jolting or twisting of the neck. Pain and rigidity at the site of injury may be accompanied by pain down the arm from injury to nerve roots. *Lateral radiograms of the spine in full flexion* are essential to exclude subluxation or dislocation. The neck should be supported by a firm collar of felt for a few weeks.

(b) *Subluxation*.—This is more common than is usually supposed and is easily overlooked unless lateral radiograms are taken with the neck in full flexion. When the neck is extended reduction takes place spontaneously. The injury may be caused by an unexpected jolt, as when a car is pulled up suddenly. Immobilization with the neck fully extended for at least two months is secured by a plaster. Persistent pain in the neck is due to adhesions, and manipulation is then called for. Recurrent subluxation may result from insufficient fixation, and a spinal bone graft is then needed.

(c) *Dislocation and Fracture-Dislocation*.—The upper part of the spine is displaced forwards, the articular processes are often locked, and frequently the lower vertebral body is crushed or an anterior marginal fragment is displaced forwards. Usually there is paraplegia from contusion or compression of the cord. The important point in treatment is traction by a Roger Anderson skull calliper gripping the zygoma, or a webbing sling under the chin and occiput. Fifteen to twenty pounds traction is employed until the articular processes are unlocked, as seen by X-rays, when the weight is reduced to 10 pounds and the spine extended. After two to three weeks a plaster is applied and in simple dislocations traction discontinued. Fracture-dislocation usually needs traction for six to eight weeks.

2. **Fractured Vertebral Body**.—Compression or comminuted fracture may follow forcible flexion. If the interarticular joints are not dislocated, immobil-

ization in plaster in full extension for three months is needed.

3. **Atlas Injuries**—(a) *Fracture* is caused by falls on the head from a height, either the posterior or the anterior arch or both being broken. Paraplegia from cord injury is present in about half the cases. The patient holds the head rigidly and may support it with his hands during movement. Fixation in plaster with the head straight for three months suffices when there is no cord injury; if paraplegia is present, skeletal traction for several weeks is called for.

(b) *Fracture-Dislocation*.—Forward dislocation of the atlas is only possible if the transverse ligament is torn or the odontoid process broken. In the former event the cord is severely crushed and survival is rare. In the latter case the prognosis is good. Plaster fixation for three months with the neck fully extended results in firm bony or fibrous union and a useful neck. In neglected cases weak fibrous union may allow increasing displacement and delayed paraplegia. Bone grafting is then indicated.

Injuries Associated with Paraplegia.—Paralysis of the body at and below the level of injury to the spinal cord is more frequently found in fracture-dislocation than in other types of fracture. In wedge or compression fracture transient paraplegia is occasionally seen from spinal concussion and recovery is complete in a few weeks. A displaced fragment of bone in comminuted fracture sometimes presses on the cord.

Dorso-lumbar fracture-dislocation is more likely to cause contusion or compression of the cord or cauda equina than actual destruction, and with efficient treatment recovery takes place in over half the cases. In the dorsal region destruction of the cord is more common and few cases recover fully. In the cervical region some regain function, but the outlook is always uncertain.

Treatment.—During the first few weeks there is a great liability to pressure sores (decubitus ulceration) owing to trophic skin changes and soiling

from urinary and rectal incontinence. This fact has led to the view that reduction and fixation should be deferred for several weeks, but the advantages of early reduction and immobilization in plaster outweigh the disadvantages. In the dorso-lumbar region a plaster jacket is used, in the dorsal region a plaster bed or a Sinclair's net bed is preferable, as paralysis is likely to be prolonged, while in the cervical region skull traction must suffice until the paralysis is passing off.

Laminectomy is seldom called for except when a depressed lamina or spinous process is pressing on the cord, or for cauda equina injuries which fail to show early recovery.

Special care is needed in all cases of paraplegia to avoid urinary infection during the first few weeks. Manual expression of urine may be tried or suprapubic cystotomy performed. Frequent catheterization or an indwelling catheter should be avoided.

Low Back Strain.—Low back pain is a symptom frequently met with and may be due to a variety of causes. In this section the traumatic causes only will be dealt with.

In investigation of this type of case the history should be carefully noted: the character and radiation of the pain, the relation to posture, early morning stiffness, etc. Careful examination of the back may elicit localized tenderness, and the effect of different passive movements should be noted.

Skiagrams should include both antero-posterior and lateral views; also stereoscopic views, if possible.

1. **Sacro-Iliac Sprain.**—There is pain over the joint, more severe in the recumbent position and during the menstrual periods. Tenderness is the rule and slight swelling is sometimes present. In the upright position the body inclines away from the affected joint, and in stooping flexion of the trunk is avoided. In acute cases spasm of the hamstrings prevents long steps in walking.

If the hip is flexed with the knee extended, pain is felt in the sacral region or down the limb, and the range of flexion is restricted (Goldthwaite's sign).

Skiagrams may show increased density of the bones, irregularity of the articular surfaces, new bone formation at the lower edge of the joint, and slight displacement at the symphysis pubis.

Treatment.—In early cases the sacro-iliac joint should be immobilized by a plaster jacket or the patient kept in bed and strapping applied from the upper thigh to the iliac crest for one to two months. A sacro-iliac belt or corset is then worn for several months.

In long-standing cases manipulation under anæ-

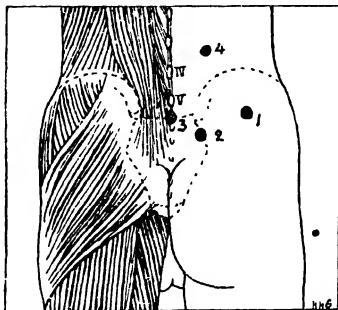


FIG. 20.—TENDER POINTS IN LOW BACK STRAIN.

1, Gluteal; 2, sacro-iliac; 3, lumbo sacral; 4, lumbar.

thesia may be tried, but in many operation is needed to fix the sacro-iliac joint. The articular cartilage is removed and a bone graft from the tibia or the ilium inserted.

2. Lumbo-Sacral Strain.—This results from injury from above with the spine in flexion. There is pain and tenderness over the lumbo-sacral joint, movements of the lumbar spine being restricted in all directions. Treatment is on the same principles as for sacro-iliac sprain.

3. Intervertebral Disc Injuries.—Rupture of the annulus fibrosus may allow prolapse of the nucleus

pulposus backwards into the neural canal, causing pressure on the nerve roots. It may be caused by falls from a height, lifting a heavy weight, manipulation of the spine, or from lumbar puncture, and is predisposed to by degenerative changes. The injury is practically confined to the lumbar region. There is pain in the lumbo-sacral region radiating along the sciatic nerve distribution, with rigidity of the lumbar spine. The pain is acute and made worse by coughing or sneezing. Skiagrams show no bony abnormality, but the disc space may be narrowed. Intrathecal injection of lipiodol followed by skiagraphy is useful in diagnosis, but is not to be undertaken lightly, as it may cause leptomeningitis and permanent ill-effects. Filling defects of the lumbo-sacral thecal space may be seen on one or both sides. Treatment is by operation, the prolapsed part of the disc being removed and the sensory root adjacent to the prolapse divided to prevent recurrence of symptoms from scarring.

4. Ligament and Muscle Injuries.—These cause low back pain and rigidity, stiffness after rest, inclination of the trunk to one side, and limitation of straight-leg raising. Localized tenderness often indicates the site of injury, and the diagnosis is confirmed by novocain injection. As the needle reaches the site there is aggravation of both local and referred pain, relieved as the novocain is injected. Treatment of recent injuries is by firm strapping, a lumbar belt, or occasionally a plaster jacket. Focal sepsis should be eradicated. In more chronic cases repeated novocain injections every few days are combined with manipulation, followed by active exercises and short-wave diathermy. Division of thickened fascial bands is occasionally needed and produces relief.

THE PELVIS

It is important to remember that the bony pelvis has three main functions: (a) transmission of the weight of the trunk to the lower extremities; (b) protection of important viscera; (c) provision of surfaces

for muscular attachments. Fractures or fracture-dislocations involving the sacro-iliac joint or that part of the pelvis between this joint and the hip call for accurate reduction and longer immobilization than the other varieties.

Injuries may be divided into (1) *complete* and (2) *incomplete*. The first group includes all injuries in which there has been distraction of the two sides of the pelvis.

1. **Complete Injuries.**—These are the most serious of pelvis injuries and are not infrequently complicated by damage to the bladder, urethra, rectum or vagina. They are due to strong antero-posterior compression, as, for instance, when the patient is crushed against a wall or run over by a motor-car. The front of the pelvis gives way and the fractured side is rotated outwards and forced backwards; this displacement is kept up by the weight of the limb.

There may be a dislocation of the symphysis or a fracture of the pubic rami anteriorly combined with either a fractured ilium or a dislocated sacro-iliac joint posteriorly. Skiagrams show the sites of fracture, but the sacro-iliac injury is liable to be overlooked unless the undue prominence of the ischial spine and alteration in outline of the obturator foramen are noted on the skiagrams (see Fig. 27).

Treatment.—Many methods are advocated to reduce the displacement, including traction on one or both limbs and pelvic slings. Watson-Jones favours postural reduction by lateral recumbency. Under spinal or general anæsthesia the patient is placed on a plaster table lying on the sound side and an assistant holds the lower limbs apart. Pressure is applied over the crest of the ilium, so as to rotate the fractured side of the pelvis inwards and towards the sound side. After reduction has been confirmed by skiagrams, a double plaster spica is applied and kept on for three months. Cases complicated by injury to bladder or urethra may be treated in this manner after operation.

2. **Incomplete Injuries**—(a) **Pubis.**—Lateral compression of the pelvis may cause fracture of the

pubic rami on one or both sides or dislocation at the symphysis. The patient should be kept recumbent for six weeks, and in spite of displacement a satisfactory result follows.

(b) **Ilium.**—Fracture is due to direct violence, and rest in bed for a few weeks suffices.

(c) **Ischium.**—Epiphyseal fracture from hamstring avulsion may occur in athletes. Union occurs readily with rest for a few weeks, as with the next two types.

(d) **Anterior Superior Spine.**—Avulsion from the pull of the sartorius is occasionally seen.

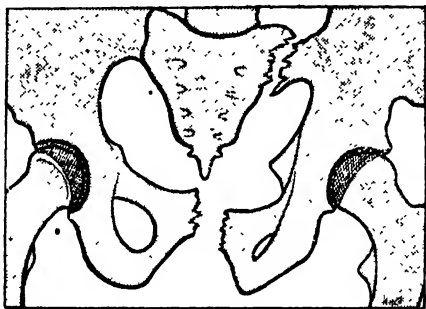


FIG. 27.—FRACTURE-DISLOCATION OF THE PELVIS.

(e) **Anterior Inferior Spine.**—The rectus femoris may avulse this part.

(f) **Sacrum.**—Crack fractures unite readily. If the lower fragment is displaced forwards, reduction should be attempted by manipulation from the rectum to avoid pressure on the sacral nerves.

(g) **Coccyx.**—Falls on the buttocks may cause bruising, fracture or dislocation of this bone. There is often great pain, made worse by sitting, which may persist for months or years. Union is slow owing to the frequent movement of the coccyx during defæcation or while sitting, and removal of the bone is often called for to relieve pain (coccydynia).

CHAPTER XXI

DISEASES OF THE SPINE

Spina Bifida.

A CONGENITAL deficiency of a portion of the posterior wall of the spinal canal, usually in the lumbo-sacral but occasionally in the cervical region, through which the spinal cord and membranes may protrude.

Varieties—1. *Myelocoele*.—The child is born with a raw area in the lumbo-sacral region, at the upper end of which the central canal of the cord opens. It is due to arrested development of the primitive medullary groove, and neural elements can be recognized microscopically in the exposed tissues. If not still-born, the child lives for a few days only.

2. *Meningocele*.—A protrusion of the spinal membranes containing cerebro-spinal fluid, the spinal cord and nerve roots being in the normal position.

3. *Meningo-myelocoele*.—The usual type. The protrusion consists of distended membranes, on the aspect of which the spinal cord or nerve roots are spread out, running across the posterior part of the cavity; the nerve roots perforate the sac to reach the intervertebral foramina.

4. *Syringo-myelocoele*.—The central canal of the cord is dilated, and the posterior portion of the spinal cord is spread out over the interior of the cyst; the nerve roots run in the wall of the sac, which is usually adherent to the skin. Trophic phenomena are a conspicuous feature.

5. *Spina Bifida Occulta*.—There is deficiency of the spinal column, but no protrusion. The overlying skin may be indurated, with a tuft of hair growing from it, or a lipoma may be present, causing nerve symptoms from pressure; pes cavus, talipes, nocturnal enuresis in children or incontinence and perforating ulcer in adults may result.

Signs and Symptoms.—In varieties 2, 3, and 4 a soft tumour is found in the mid-line of the back, usually in the lumbar region. The skin over it may be normal,

or thin and translucent with dilated vessels. The tumour can be diminished in size by pressure, which

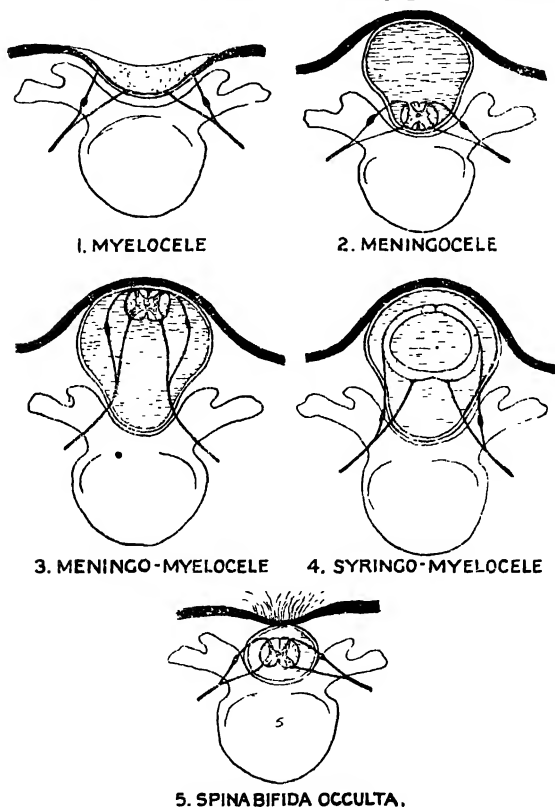


FIG. 28.—VARIETIES OF SPINA BIFIDA.

may result in bulging of the anterior fontanelle with convulsions, and there is an expansile impulse on crying. The bony deficiency in the spinal column

may be felt, or seen in skiagrams. Associated deformities, *e.g.* talipes or hydrocephalus, and trophic lesions are not unusual, especially in syringo-myelocele. A shadow on transillumination, a depression in the centre of the posterior wall, or a vertical median furrow indicate that there are nerve elements present in or adherent to the sac. In spina bifida occulta skiagrams clinch the diagnosis.

Prognosis.—If the skin is thin it may give way with escape of cerebro-spinal fluid, and death follows from septic meningitis. If the tumour is small and covered with healthy skin the patient may reach adult life, and trophic changes may then supervene from the growth of nævoid tissue in the spinal canal. In meningocele spontaneous cure sometimes occurs from obliteration of the neck of the sac.

Treatment.—In meningocele the sac is excised; in meningo-myelocele the nerve elements may be dissected off the skin, or the strip of skin to which they are adherent may be separated and replaced with them in the spinal canal. The muscles and superficial tissues are then approximated, and to effect this it may be necessary to undermine the muscles freely through lateral incisions parallel to the middle line. In spina bifida occulta with late onset of nervous symptoms good results may follow the extirpation of the fibrous band which may be found passing from the superficial tissues down to the nerve roots or cord itself.

Sacro-coccygeal Tumours.

The sacro-coccygeal region is one in which certain unusual types of tumour are prone to occur, some of them arising in embryonic remains such as the notochord and post-anal gut or neurenteric canal.

Classification :

1. Cysts :

- (a) *Dermoid.* This may arise from proctodeal remnants or from the neurenteric canal.
- (b) *Cysts arising from post-anal gut.*
- (c) *Meningeal.*

11. *Tumours :*

- (a) *Lipoma, fibroma, myxoma, chondroma.*
- (b) *Glioma.*
- (c) *Neuroblastoma.*
- (d) *Chordoma.*
- (e) *Teratoid tumour.*
- (f) *Teratoma.*
- (g) *Parasitic fœtus.*
- (h) *Sarcoma.*
- (i) *Carcinoma.*
- (j) *Endothelioma.*

SPINAL COLUMN

Acute Osteomyelitis.—This is uncommon, but occurs in young people. The prognosis is bad owing to the danger of meningitis.

Tuberculosis of the Spine (*Pott's Disease*).—The majority of cases occur in children under five, but neither youth nor old age is exempt. The bovine variety of *Bacillus tuberculosis* is responsible for nearly half the cases. The lower dorsal spine in children and the dorsi-lumbar region in adults are the parts usually involved. The onset, usually slow, may be acute.

Pathology.—The primary focus is practically always in the body of a vertebra, and may be periosteal in adults but is endosteal in children. The anterior parts of the body are those usually affected, and caries spreads from the epiphysis, either through the intervertebral disc or under the anterior common ligament, to adjacent vertebræ. Multiple foci are not rare. Softening and collapse from the weight of the trunk or from muscular action are followed by backward deformity, which is frequently angular (angular kyphos). Abscess formation may occur or the tuberculous process may spread backwards, causing pressure on the cord. When healing takes place, it is by a process of ankylosis between adjacent vertebræ.

Signs and Symptoms.—The five most prominent are :

1. *Pain.*—A constant feature, and of two distinct kinds: (a) Local, of an aching character and intensified

by movements of the spine or percussion over the diseased area; and (*b*) referred, due to pressure on nerve roots in the intervertebral foramina and radiating along their distribution. In disease of the lumbar region pain may be felt in the legs; of the lower dorsal region in the abdomen; of the cervical in the arms.

2. *Rigidity*.—Invariably present. At first due to muscular spasm, later it results from ankylosis. It can be seen or felt during active movements such as bending, or in children by attempts at passive hyper-

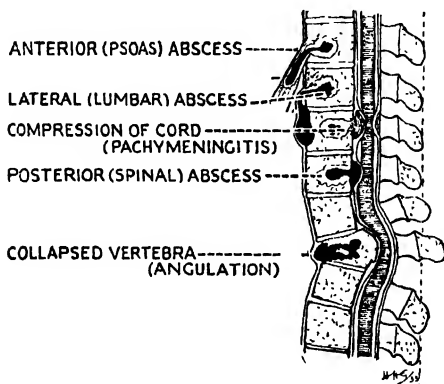


FIG 29.—PATHOLOGY OF POTT'S DISEASE OF DORSI-LUMBAR REGION.

extension with the child prone, when, instead of the back bending freely, the body is raised as a whole.

3. *Deformity*.—When the disease is confined to two vertebrae, backward angular curvature results; when several are affected, the curvature is more general and less obvious. In the dorsal region kyphosis is striking, the ribs are crowded together, and the sternum bulges anteriorly. In the cervical and lumbar regions the normal forward curves are lost and the spine appears straightened. In all cases the erect posture is maintained by the development of compensatory curvatures.

4. *Abscess Formation*.—Is seen relatively more often in adults, and is of serious import. Usually commencing deep to the anterior common ligament, the abscess spreads to the sides of the vertebræ and tracks for long distances before coming to the surface. In the cervical region it passes behind the prevertebral fascia, forming a retropharyngeal abscess, which may present (i.) on the posterior wall of the pharynx, (ii.) in the posterior triangle, (iii.) in the axilla, or (iv.) it may spread to the mediastinum. In the dorsal region the abscess may (i.) appear to the outer side of the erector spinæ, forming a swelling which has an impulse on coughing (dorsal abscess); (ii.) extend along the rib and point where the lateral branch of the inter-

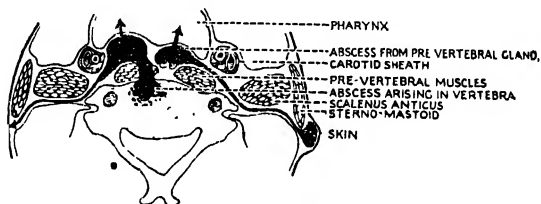


FIG. 30.—TRANSVERSE SECTION OF NECK ILLUSTRATING MODE OF SPREAD OF RETROPHARYNGEAL ABSCESS.

On left, tuberculous; on right, pyogenic.

costal artery becomes superficial; (iii.) track further forward and appear at the side of the sternum or at the costal margin. In the dorsi-lumbar and lumbar regions a lumbar abscess may form, to the outer side of the erector spinæ between the last rib and the iliac crest, or a *psoas* abscess, which may be felt in the iliac fossa or may track under Poupart's ligament behind the femoral vessels and form a swelling in the adductor region or near the saphenous opening.

5. *Peculiarities of Gait and Attitude*.—In cervical disease there may be torticollis and the head is often supported by the hand. When the thoracic spine is affected the shoulders may be raised and the arms and shoulders pulled backwards. In lumbar disease

there is marked lordosis and the patient often waddles with the legs wide apart (aldernian's gait). In all cases the child walks gingerly, taking care to avoid any sudden jarring of the spine.

Prognosis.—This is greatly influenced by the stage of the disease at which treatment is begun and by the site of the lesion, the thoracic spine being the least favourable. The mortality in sanatoria is low, but the ultimate death-rate is considerable, varying from 20 to 50 per cent. according to different authorities.

Diagnosis.—In the early stages this is difficult, the most reliable sign being rigidity. Skiagrams will assist in differentiating the condition from fibrositis, intercostal neuralgia, simple curvatures, visceral disease, tumours and syphilis of the spine (including Charcot's disease), and lastly aneurysm.

Treatment—General—This is as for tuberculosis elsewhere, residence in a sanatorium being desirable.

Local.—1. Prolonged immobilization (two to five years) with the spine in hyperextension is essential. This can be achieved by many forms of apparatus—a modified Whitman's frame angulated opposite the lesion is often used. When the disease has become quiescent (*i.e.*, when skiagrams show that bone destruction has ceased for at least six months and recalcification is occurring) the patient is placed in the prone position in a plaster shell and the muscles of the back are exercised.

2. Spinal supports. Plaster or celluloid jackets or a leather or metal brace, such as Taylor's, are employed to support the spine for a prolonged period after walking is permitted.

3. Operation. The object of this is to shorten the period of treatment, but many authorities are opposed to operative measures. Albee's operation: An autogenous bone graft from the tibia is inserted into the split spinous processes. Hibb's operation: The spinous processes are broken and turned so that they interlock and fuse; in addition, an arthrodesis of the intervertebral joints is performed.

4. Abscesses. Aspiration, irrigation, and closure

without drainage may all be needed; the greatest care must be taken to avoid secondary infection.

Paraplegia.—This grave complication occurs in about 10 per cent. of cases. Three types may be distinguished:

(1) *Paraplegia of early onset which recovers completely* if the patient survives. This type is usually complete and clears up as the bone lesion improves.

(2) *Paraplegia of early onset which persists permanently* even when the bone lesion has become quiescent.

(3) *Paraplegia of late onset*, which may not occur until the bone disease has been apparently quiescent for many years. It is usually partial, and most cases recover.

• In the first type the paraplegia is due to toxic and vascular changes in the cord, together with compression by granulation tissue or pus. The second type is due to atrophy of the cord, and may be associated with a sequestrum or pathological dislocation of the spine. In the third type paraplegia is due to renewed activity in the old focus.

Treatment.—Efficient conservative treatment will result in recovery in 70 per cent. of cases. Costo-transversectomy is sometimes indicated for drainage of an abscess in early cases. Laminectomy is rarely called for, and should be combined with grafting to prevent subsequent collapse of the spine.

Spondylitis Deformans.—A form of osteo-arthritis affecting the spinal column, found in old people and in those whose occupation has involved heavy work in a bent position—*e.g.*, miners and agricultural labourers. Rigidity and kyphosis result from absorption of intervertebral discs, ankylosis of vertebræ, ossification of ligaments and formation of osteophytes. Pain, due to the irritation of nerve roots, is often severe and of the referred type. Two main forms of the disease occur: (1) Von Bœchterew's, affecting the upper cervical and dorsal regions, with flattening of the chest and fixation of the ribs; (2) Strümpell-Marie, affecting the lower spine and in addition the shoulder and hip joints. In both types ankylosis between

ribs and vertebrae is liable to develop, followed by respiratory diseases.

Traumatic Spondylitis.—A condition which develops in a patient who has had a severe injury to the spine; after return to work, persistent pain and stiffness are complained of, and later a localized angular kyphosis or scoliosis appears. It is thought to be due to an unrecognized compression fracture of the spine, with subsequent bending owing to weight-bearing while the callus is still soft. Skiagrams show an alteration in the shape of the vertebra with excessive formation of new bone.

Kümmell's Disease.—Develops after a comparatively slight injury to the spine, the patient complaining of pain and weakness in the back, followed later by neurasthenia. Skiagrams of the dorsi-lumbar region disclose atrophied vertebral bodies which may be fused and irregular in outline. The condition is thought to be due either to disturbed nutrition of the bones as the result of injury to the smaller vessels with thrombosis, or to trophic disturbance following injury to the nerves or spinal cord. The vertebral bodies may become wedge-shaped, producing kyphosis. The spine should be fixed in a position of hyperextension by a plaster jacket, followed by a spinal brace, for at least eighteen months. In young adults, bone grafting has been employed with success.

Syphilitic Spondylitis.—This is rare, but may give rise to symptoms and signs resembling Pott's disease; most cases occur in adults and affect the cervical region. The rapid progress, signs of syphilis elsewhere, and positive Wassermann reaction are of value in diagnosis. *Gonococcal*, *rheumatoid* and *typhoid arthritis* all occur occasionally in the spine, giving rise to pain, stiffness and disability.

Painful Sacralization.—An abnormal enlargement of the fifth lumbar transverse process, which may fuse or articulate with the sacrum or ilium. Radiating pain is complained of after movements of the spine, and a tender spot is present just above the sacro-iliac joint. If rest, pelvic supports and diathermy fail, manipulation should be tried.

Coccydynia.—Intractable neuralgia in the coccygeal region, which is tender on pressure. The condition may follow injury or childbirth, or arise spontaneously. In some cases there is a strong neurotic element; in others, deformity and fixation of the coccyx may be responsible and justify excision of the bone if other measures fail.

Tumours of the Spine.—*Osteoma*, *chondroma* and *fibroma* are all very rare. *Primary sarcoma* occurs in adults in the dorsal region, closely resembling Pott's disease; local and radiating pain unrelieved by recumbency are as a rule prominent features. The progress is rapid, curvature and paraplegia may develop, and death results. *Secondary carcinoma* is common, the primary growth being usually in the breast, prostate, kidney, bronchus or thyroid. *Secondary sarcoma* also occurs.

Prolapse of the nucleus pulposus of the intervertebral disc is an occasional cause of lesions of the cord and cauda equina. It is amenable to laminectomy. (See p. 254.)

• SPINAL CORD

Acute Spinal Meningitis.—Sometimes seen after infected wounds of the spine. A rigor is followed by persistent high temperature. There is severe pain in the back and limbs, increased by movement, also rigidity and painful muscular spasm; hyperæsthesia and increased reflex excitability are present in addition. Paraplegia, bedsores and bladder troubles follow, death usually resulting from spread to the brain.

Chronic Spinal Meningitis (*Meningitis Circumscripta Serosa*).—This may supervene on injuries inflicted weeks or months before. The membranes become thickened, with adhesions to the cord and loculation of the subarachnoid space. The symptoms are localized pain and rigidity of the back, with shooting pains, hyperæsthesia and muscular spasm. The reflexes are exaggerated and bladder complications may ensue. Paraplegia due to compression of the cord may supervene. Laminectomy may afford relief.

Spinal Myelitis.—May follow injury to the spine, meningitis or pressure on the cord. In acute myelitis the structure of the cord is quickly destroyed; in chronic cases, the nerve tissues are compressed by cicatricial contraction.

1. *Acute Myelitis.*—Pain, hyperæsthesia and muscular cramps are soon followed by paralysis. The reflexes vary according to the extent of the disease. The sphincters of the bladder and rectum are frequently paralyzed, septic cystitis and bedsores ensue and often prove fatal.

2. *Chronic Myelitis.*—Paresis occurs, gradually followed by paralysis; hyperæsthesia is slowly replaced by anæsthesia, together with bladder and rectal troubles.

Treatment.—Symptomatic.

Spinal Neurasthenia.—Usually follows a severe accident associated with profound mental upset—*e.g.*, railway accidents (railway spine), in which the spine has presumably been jarred. There is usually no evidence of injury to spinal column or cord. The patient may be dazed at the time of the accident and later notices pain in the back, inability to concentrate, neuralgic pains and weakness. The bladder and rectum are seldom affected, and sensation is either normal or hyperæsthesia is present. The reflexes are exaggerated. Recovery usually takes place in time, especially when mental anxiety as to compensation has been removed.

Tumours of the Spinal Cord and Membranes.

These may arise in one of three situations:

1. *Extrathecal.*—Lipoma, neurofibroma and sarcoma occur. Symptoms of spinal irritation—*i.e.*, radiating pains, etc.—precede those of pressure on the cord.

2. *Intrathecal.*—The most important are fibroma, psammoma, fibrosarcoma and endothelioma. Gumma in this situation may give rise to a similar picture. Paræsthesia followed by pain due to posterior root irritation may precede cord symptoms by many

months. Later Brown-Séquard hemi-section phenomena may arise or occasionally paraplegia.

3. **Intramedullary.**—Glioma and sarcoma both occur. Paraplegia may affect both sides or be of the crossed type, anæsthesia then being present on one side, paralysis and hyperæsthesia on the other. Root pains in these lesions tend to be late.

Diagnosis.—Localization of the site of a spinal tumour is a matter of great importance. A complete neurological examination of motor, sensory and reflex functions will usually enable this to be done. Injection of lipiodol into the subarachnoid space in the cerebellar region (cistern puncture), followed by skiagrams of the spine, will reveal a block at the site of the tumour; cerebro-spinal fluid withdrawn from below the lesion may be yellowish in colour, with a high percentage of albumen and increased globulin (loculation syndrome). Comparison of the variations in the pressure of the cerebro-spinal fluid, after compression of the jugular veins or straining, may show differences above and below the suspected lesion.

Treatment.—The possibility of syphilis must always be excluded, and in cases of doubt potassium iodide and mercury should be given a short trial. Once the diagnosis is established, laminectomy should be performed and, if possible, the tumour removed; in about half the cases this can be successfully achieved. In intramedullary tumours the cord may be divided over the growth, and removal may then be possible at a later stage, spontaneous extrusion of the tumour having taken place in the interval.

CHAPTER XXII

AFFECTIONS OF THE SCALP AND CRANIUM

THE SCALP

Wounds.—Free hæmorrhage is liable to occur, and if the aponeurosis of the occipito-frontalis is divided, the loose cellular tissue between it and the pericranium

is opened and cellulitis of a serious nature may follow. The blood supply of the scalp is good and contained in the subcutaneous tissues, so that large flaps may be torn back and still retain their vitality.

Hæmatoma.—Three varieties are recognized:

1. *Subcutaneous.*—Usually of small size owing to the density of the subcutaneous tissue.

2. *Subaponeurotic.*—Limited by the attachments of the occipito-frontalis aponeurosis, forming a large fluctuating swelling extending forwards to the supra-orbital ridges.

3. *Subpericranial.*—Limited by the pericranium to one or other of the skull bones, usually the parietal. The edges often become indurated, and the condition then simulates a depressed fracture. In a hæmatoma, however, the edge pits on pressure and is raised above the surrounding cranium. This type often results from injuries at birth.

Abscess.—This may arise from infected wounds or hæmatomata, or from underlying bone disease. The same types are recognized as in hæmatoma.

Erysipelas and Cellulitis.—These have already been referred to (see pp. 22 and 18).

Tumours and Cysts—1. *Cirroid Aneurysm.*—This is more common in the temporal region than in any other part of the body. A tumour is seen consisting of tortuous, pulsating vessels, covered by thin, atrophied bluish skin, and giving rise to headache and giddiness. It can be diminished by pressure, but quickly expands again. Excision in two stages, ligature of the main vessels and diathermy are the only methods of treatment. If neglected, death usually supervenes from ulceration of the skin and hæmorrhage.

2. *Nævus.*—The capillary and cavernous varieties are both common in children.

3. *Papilloma and Epithelioma.*—By no means uncommon.

4. *Sebaceous Cyst.*—This is very common, and frequently multiple (wens). If not removed, supuration is very liable to occur.

5. *Dermoid Cyst.*—Quite common, the usual situa-

tions being near the outer canthus or at the root of the nose. The underlying bone may be hollowed out and a pedicle may pass down to the dura mater.

6. *Sebaceous Adenoma*.—A solid tumour which varies in its rate of growth, and is liable to recur locally after removal. Microscopically it is not unlike a rodent ulcer.

7. *Lipoma* occasionally occurs under the aponeurosis, and may cause errors in diagnosis.

8. *Neurofibroma*.—This may form a large pendulous mass (pachydermatocele).

9. *Sarcoma*.—This forms a large pulsating or fungating mass, and is usually an extension from cranial or intracranial sarcoma.

10. *Rodent Ulcer*.—Usually involves the scalp by extension from the face.

HEAD INJURIES

Fractures of the Skull—Causes.—1. Direct violence, which may be localized or diffuse. Most fractures of the vault, fissured or depressed, arise in this way from blows, falls or gunshot wounds. At the base of the skull direct violence may be applied (*a*) through the orbit, fracturing the anterior fossa; (*b*) through the condyle of the jaw, breaking the middle fossa, and (*c*) through the impact of the vertebral column against the occipital condyles, fracturing the posterior fossa. Irradiation of the fracture from vault to base or *vice versa* often occurs.

2. Indirect violence. Compression of the skull beyond the limits of its elasticity results in fracture at the weakest point.

Varieties—1. *Simple Fissured*.—Produced by blows with blunt objects, frequently extensive, and may involve the base as well as the vault. Often unsuspected until skiagrams are taken.

2. *Compound Fissured*.—A scalp wound is present and the fracture may be seen as a red or dark streak, which is not serrated as is a suture; it may also be felt as an irregular ridge. The inner table may be depressed or the dura mater lacerated, with the result

that chronic headache, Jacksonian epilepsy or mental changes follow. Careful treatment of the wound is always necessary, and trephining may be desirable to meet special indications.

3. *Simple Depressed*.—More common in children. The shallow depressions met with in infants often disappear spontaneously; all other cases should be trephined and the depressed portion elevated.

4. *Compound Depressed*.—There may be extensive fissuring in addition to the depression. All cases should be trephined.

5. *Fractures of the Base*.—These may be longitudinal, oblique or transverse, and either limited to one fossa or involving two or more. The majority are compound, communicating with nose, mouth or ear, and associated with severe injury to the brain or intracranial vessels; sepsis is liable to supervene.

Signs and Symptoms.—1. Concussion and cerebral laceration, which may be followed by cerebral irritation or compression and later meningitis.

2. Hemorrhage: (a) From the nose or mouth, in fractures of anterior, middle or posterior fossa when the ethmoid, basi-sphenoid or basi-occipital respectively are broken. (b) From the ear, in fractures of the middle or posterior fossa. [Other injuries may give rise to this without a fracture of the skull: (i.) rupture of tympanic membrane, (ii.) fracture of the tympanic plate, (iii.) fracture of the external auditory meatus, (iv.) injury to the cartilage of the pinna.] (c) Into the orbit in fracture of the anterior fossa. Some hours after the injury, subconjunctival extravasation of dark blood, triangular in shape, may appear: the posterior limit cannot be seen and proptosis may be present, effusion into the lower lid following later. (d) Into the neck muscles, resulting in ecchymosis at the nape, in fractures of the posterior fossa.

3. Escape of cerebro-spinal fluid. Large quantities may leak through the middle ear. It is a watery fluid, of specific gravity 1,005 to 1,008, does not coagulate on boiling, but reduces Fehling's solution. It may also escape into mouth, nose, or pharynx, and detection is then more difficult.

4. Escape of brain matter. Occurs in severe cases, especially gunshot wounds.

5. Injuries to cranial nerves. The facial is the nerve usually involved, and paralysis may come on immediately from rupture or bruising, or after two to three weeks from pressure of callus. The prognosis is bad in the former, but recovery usually takes place in the latter within three months. The auditory nerve is often injured with the facial, and deafness is usually permanent. Injury to the third, fourth and sixth nerves may occur in fractured anterior or middle fossa, and ocular paralysis results. The olfactory nerve is frequently injured, but the resulting loss of smell is usually overlooked. Other cranial nerves are rarely affected.

• **Treatment.**—(1) Rest in bed for three to six weeks. (2) Treatment for concussion or cerebral irritation if present (see below). (3) Disinfection of external auditory meatus and sterile dressing in cases with bleeding or discharge of cerebro-spinal fluid from the ear. (4) Operation if marked symptoms of compression are present, subtemporal or occipital decompression being carried out. (5) Prolonged mental rest (three to six months). (6) Chemotherapy for compound fractures.

Cerebral Concussion.—A condition of shock due to an injury to the head. In fatal cases evidence of cerebral injury may be lacking, though punctate hæmorrhages into or actual disorganization of brain tissue may be found. The cause is probably a severe general compression of the brain resulting in anæmia; this produces immediate widespread paralysis, from which spontaneous recovery often occurs.

Signs and Symptoms.—The condition may be momentary or last for some hours. (1) Unconsciousness may be partial or complete. (2) Respiration is shallow and slow. (3) Pulse may be rapid or slow, weak and irregular. (4) Surface is pale, cold, and clammy. (5) Pupils are usually dilated, equal and react sluggishly if at all; the conjunctival reflex is present. (6) Temperature is subnormal. (7) Sphincters are relaxed, incontinence of bladder and rectum resulting.

(8) Reflexes are sluggish or absent in severe cases. In milder degrees many of these features are absent or modified.

Results.—(1) Reaction. Vomiting is usually the first indication, occasionally a convulsion occurs. The patient turns on his side, the pulse improves and becomes slow and full. Consciousness is regained and the patient may be irritable or complain of headache. Permanent defects may be left, such as impairment of vision, hearing or memory, and neurasthenia. (2) Cerebral irritation or compression. (3) Death.

Treatment.—(1) Rest in bed for three weeks or more with the head low in severe cases. (2) Warmth in the shape of hot blankets and bottles, or an electric cradle. (3) Avoidance of stimulants. (4) After reaction has set in, a purge should be given and the patient kept on low diet. (5) All mental effort and excitement should be avoided for some weeks and fresh air and light diet encouraged. In mild cases a less rigid régime may be permitted, but no case of concussion should be regarded as unimportant, and the onset of cerebral compression and other complications should be watched for.

Cerebral Irritation.—A condition of marked mental irritability following concussion and due to contusion or laceration of the frontal and anterior parietal regions.

Signs and Symptoms.—Appear after the period of concussion is over. The patient is restless and lies curled up on his side, with the eyes shut. Attempts to open them are resisted both physically and by forcible language. The pupils are usually contracted. Urine and motions may be passed into the bed. The patient, though not unconscious, pays no regard to his surroundings, but is violently irritable if disturbed. He may complain of headache, nausea and giddiness. After a variable period the irritation subsides, and he may become childish, though in time recovery usually follows. Occasionally chronic meningitis is a sequel.

Treatment.—Rest and quiet are essential. The head should be shaved and cold applied. The diet

should be light and nourishing, purgatives are necessary, and bromides useful. Lumbar puncture will often produce a marked improvement, the cerebro-spinal fluid being gradually released to 100 mm. water pressure. Sometimes it is necessary to adopt such measures for relief of intracranial pressure as indicated under Cerebral Compression (*vide infra*).

Cerebral Compression.—By this is meant a general compression of that portion of the central nervous system within the cranium. It may be due to various causes: (1) Hæmorrhage, which may be extradural, intradural or intracerebral; (2) abscesses in the same situations; (3) tumours; (4) depressed fractures; (5) inflammatory exudates, produced in various ways.

. Local pressure—*e.g.*, depressed fracture on any part of the brain—may cause focal symptoms only, or be associated with a spreading œdema, due to the fact that the thin-walled veins are more easily obstructed than the arteries, with the result that venous stagnation and exudation occur. This sets up a vicious circle, and gradually the pressure becomes raised over a wider area. In other cases, general extravasation of blood or inflammatory exudates into the subarachnoid space produces similar effects. At first cerebro-spinal fluid is displaced, but after a time the intracranial pressure rises; eventually the circulation in the brain is interfered with and cerebral function suffers. Stimulation of the medullary centres is followed by depression and paralysis, the last to suffer being the respiratory and cardiovascular.

Causes.—1. *Extradural.*—Depressed fracture, foreign bodies, hæmorrhage, abscess and tumours of the skull.

2. *Intradural.*—Hæmorrhage, abscess and meningitis.

3. *Intracerebral.*—Cerebral hæmorrhage or laceration, abscess, tumour and gumma.

Signs and Symptoms.—In those cases resulting from accidents the symptoms are preceded by those of concussion, with or without a lucid interval of some hours. (1) Mental state: Drowsiness and coma are preceded by headache. (2) Pulse: At first the rate gradually diminishes, the beat being full and the blood

pressure high; later the pulse becomes rapid and irregular. (3) Respiration is slow and stertorous from paralysis of the soft palate and cheeks, followed later by Cheyne-Stokes breathing and respiratory failure. (4) Temperature: This is low at first, then rises to 100° to 103° , more on the side opposite to the lesion than on the affected side. Hyperpyrexia is found in pontine lesions. (5) Paralysis of muscles: This may commence in one limb (monoplegia) or on one side (hemiplegia); in other cases localized spasms or convulsions may occur. (6) Pupils: At first unequal; later both are dilated and fixed. The pupil on the side of the lesion is first contracted and then dilated, while that on the opposite side undergoes similar changes later. The optic discs show papillœdema. (7) Bladder: Retention of urine with overflow may be followed by true incontinence. (8) Rectum: Incontinence of fæces or obstinate constipation is found. (9) Reflexes: These may differ on the two sides in the early stages, but later disappear.

Diagnosis.—Other causes of coma must be excluded:

(1) Diabetes (acetone in breath, sugar in urine); (2) uræmia (urine contains albumen, tongue is dry, breath characteristic); (3) alcoholic poisoning (smell of breath, history); (4) opium poisoning (pin-point pupils and characteristic odour); (5) cerebral hæmorrhage, thrombosis or embolism (disease of arteries and heart); (6) epilepsy (history of fits); (7) sunstroke.

Treatment.—(1) Remove any local cause if possible. (2) Subtemporal or suboccipital decompression when the local cause cannot be removed. (3) In cases of slight compression, rest, quiet, light feeding and purges are the indications, supplemented by intravenous injection of hypertonic saline (50 c.c. of a 20 per cent. solution) or glucose (50 c.c. of 50 per cent. solution), and rectal injections of concentrated magnesium sulphate (1 ounce in a few ounces of water).

Cerebral Laceration.—Is present in practically all cases of head injury associated with cerebral symptoms. It may vary from (a) minute petechial hæmorrhages to (b) localized extravasations of blood in or on the surface of the brain, either at the

point struck or on the opposite side (contrecoup), or (c) laceration of brain matter, which is followed by softening.

Results.—(1) Spreading oedema may follow and cause compression. (2) Absorption may be complete. (3) Localized fibrosis may be responsible for focal symptoms such as Jacksonian epilepsy, aphasia, or localized paralysis. (4) Diffuse sclerosis may result in mental changes. (5) Blood cyst formation.

Symptoms.—There are no special symptoms by which cerebral laceration can be identified, since they are masked by concussion, cerebral irritation and compression.

Intracranial Hæmorrhage.

This may be extradural, subdural or intracerebral.

Extradural Hæmorrhage is uncommon in children owing to the firm fixation of the dura to the skull. The commonest form is from the middle meningeal artery, but other meningeal vessels and the superior longitudinal, lateral and cavernous sinuses may be the source of the bleeding.

Middle Meningeal Hæmorrhage.—This may occur with or without a fracture of the skull. In some cases the artery may be injured on the side opposite to the blow. In 90 per cent. of cases the anterior branch is involved, usually where it crosses the antero-inferior angle of the parietal bone; in the remainder either the posterior branch or the venous plexus running with the artery is injured.

Signs and Symptoms.—These are often obscured by some other lesion. Typically three stages occur: (1) Concussion, which may be absent or last for a few minutes only. (2) Lucid interval of a few minutes to several hours or a day or two. The patient is conscious and may feel quite normal. (3) Cerebral compression. Severe pain in the head and vomiting may precede the onset of coma. (4) Twitchings of the hand and arm, followed by flaccid paralysis on the side opposite to the lesion. (5) Passive congestion of the eyeball, proptosis and paresis of ocular muscles

may result from pressure on the cavernous sinus. (6) Pupils: Contraction on the side of the lesion is followed by dilatation. (7) Lumbar puncture shows a clear fluid containing no blood.

Prognosis.—This is grave owing to associated lesions, non-expansion of the brain after operation or to spreading œdema.

Treatment.—Immediate operation. Trephine at a point $1\frac{1}{2}$ inches above and behind the external angular process, remove blood clot and look for the bleeding point, which must be undersewn with a catgut suture or plugged with sterile wax or a match if in the bony canal. In many cases after removing blood clot there is not enough bleeding to justify anything but the insertion of a rubber drain. If the brain expands and pulsates the wound should be closed without drainage. If no bleeding point is found, the posterior branch of the middle meningeal artery on the same side should be explored through a trephine hole above and behind the ear. If this is unsuccessful, the same sequence should be followed on the opposite side.

In extradural hæmorrhage from the smaller meningeal arteries or the venous sinuses, spontaneous arrest of bleeding may occur, and the symptoms of compression are not so severe.

Intradural Hæmorrhage.—This may be subdural, subarachnoid or intracerebral. The internal carotid and vertebral arteries, the meningeal vessels, venous sinuses or cerebral vessels may be its sources. The symptoms of concussion are followed by those of compression without any lucid interval. In a few cases localization is possible owing to focal symptoms such as muscular spasm and paralysis. Lumbar puncture shows a blood-stained cerebro-spinal fluid.

Treatment.—Absolute rest in all cases. If focal symptoms or localized injury point to the site of pressure, trephine over this, open the dura, remove clot and tie or underrun any bleeding point or plug with gauze. In most cases subtemporal or suboccipital decompression on one or both sides is all that is possible.

Chronic Subdural Hæmorrhage.—In these cases the patient recovers from the accident, which may have been slight, but during the next few weeks complains of severe headache and attacks of giddiness. Mental changes are often prominent, irritability, mental confusion, drowsiness or delirium being found. The physical signs vary from day to day, reflexes altering from those of hemiplegia to normal. Unilateral congestion of the retinal veins may often be found, rarely papilloedema. After a variable time vomiting is followed by coma and hemiplegia. At operation an encysted subdural hæmorrhage is found.

Intracranial Hæmorrhage from Birth Injuries.—This is responsible for a large number of cases of so-called congenital and infantile hemiplegia, monoplegia, paraplegia and diplegia (Little's disease), and for dementia and idiocy. The hæmorrhage is usually subdural, and comes from veins running between the brain and the superior longitudinal sinus or the tentorium cerebelli. Pressure of obstetrical forceps, vigorous artificial respiration or excessive moulding of the skull bones during labour are responsible. Convulsions may ensue during the first few weeks and spastic paralysis at a later date.

Treatment.—Wide reflexion of the scalp and skull, followed by removal of blood clot or by multiple trephine holes through which the clot is washed or sucked out.

After-Effects of Head Injuries.

1. **Headache.**—(a) Generalized and throbbing, coming on in attacks after exertion, excitement or fatigue. (b) Localized persistent pain over the site of injury (traumatic cephalalgia) frequently associated with a scar in the scalp, sclerosis of the skull or meningeal adhesions.

2. **Amnesia (Loss of Memory).**—This usually embraces a short period preceding and following the accident, occasionally extending to long periods before or after the injury: sometimes it is complete.

3. Giddiness and noises in the head.

4. **Mental Changes.**—Irritability, loss of concentration, changes of disposition, liability to alcoholism, drug habits or sunstroke.

5. **Sensory and Motor Systems.**—Monoplegia, hemiplegia, sensory or motor aphasia.

6. **Special Senses.**—Loss of smell, sight or hearing.

7. **Traumatic Epilepsy.**—This may be idiopathic or Jacksonian. In the latter the lesion is usually in the Rolandic area, and may be in the skull, meninges or cortex; depressed bone, fibrous thickening or a blood cyst may be responsible. Encephalography and electro-encephalography may enable localization of the damaged cerebral cortex. The fit begins in one group of muscles, which are enfeebled between the attacks, and spreads in orderly sequence to other groups until it may become general, with loss of consciousness. In some cases an aura, such as tingling or aphasia, is the first sign. After the fit the patient may be in a state of post-epileptic coma. The intervals between the fits tend to become shorter, until a status epilepticus is set up; mental degeneracy and insanity usually follow.

Treatment.—Operation is useless except in some cases of headache or Jacksonian epilepsy. In these, the affected area should be explored and any cause removed. If no gross lesion is found, it is sometimes justifiable to remove the portion of the motor cortex supplying the muscles in which the fit commences; temporary relief often follows, but there is a liability to recurrence, owing to scarring and adhesions, which may, however, be minimized by 'amnioplastin.'

In all cases prolonged mental rest and sedatives such as bromides and luminal are indicated.

THE SKULL

Acute Infective Osteomyelitis.—This may occur by direct infection through a scalp wound or compound fracture, through the blood stream, or by extension from disease of the frontal sinus or mastoid antrum. The outer table alone or both outer and inner tables

may be involved, and there is grave risk of meningitis and other intracranial complications.

Tuberculous Osteitis.—This is uncommon, affects children as a rule and leads to the formation of a cold abscess which may burst, leaving a sinus down to carious bone.

Syphilitic Osteitis.—Craniotabes, Parrot's nodes, and gummatous infiltration, which may be localized or diffuse with sclerosis, all occur.

Pneumatocele.—A collection of air under the pericranium. It may be traumatic, following fracture in the region of the frontal sinus or the mastoid cells, or spontaneous, as the result of necrosis of bone in inflammatory conditions of the same parts.

Osteoma.—Both ivory and spongy osteoma occurs, the former arising especially from the frontal bone or external auditory meatus, and in some cases is multiple. Cerebral irritation or pressure may result if the inner surface of the calvarium is the part mainly affected.

Chondroma may arise from the cartilage bones of the base of the skull and projects into the middle and posterior fossæ.

Sarcoma.—This may be primary or secondary. The primary form is an osteogenic sarcoma which spreads rapidly, both externally and between the dura mater and the bone; infiltration of the dura and brain is delayed, although pressure symptoms may arise before this has taken place. The tumour is often soft, and both fluctuation and pulsation may be present. The secondary form follows sarcoma of the kidney in children, and is often multiple.

Chondro-sarcoma may develop from sites similar to chondroma and produces pressure on the brain stem, etc.

Chordoma develops in the basisphenoid and basioccipital and possesses characteristic 'foamy' cells.

Secondary Carcinoma.—The primary growth may be in any part of the body, but is usually in the breast, thyroid gland, prostate or kidney (hypernephroma).

In the case of the thyroid, the primary growth may appear innocent; the metastases in the skull are often multiple and may pulsate.

CHAPTER XXIII

DISEASES OF THE BRAIN AND MEMBRANES

Cephalocele.—A protrusion of the brain or its membranes through a congenital defect in the skull, associated with increased intracranial pressure. The most frequent situations are the middle line, in the occipital region, the root of the nose, or the mouth or pharynx; it also occurs at the lateral fontanelle. The sac is formed of meninges and scalp, the skin being either normal, thin, hairless and shiny, or affected by a nævoid condition. Later, ulceration is common.

Varieties—1. **Meningocele.**—The sac consists of the membranes and contains cerebro-spinal fluid only; the opening in the skull may close, shutting the tumour off from the cranial contents. It forms a soft, fluctuating swelling, which increases in size on expiration, crying or coughing, and can be diminished in size by pressure. It is translucent when large.

2. **Encephalocele.**—This contains in addition brain substance, pulsates with each heart beat and is not translucent.

3. **Hydrencephalocele.**—This occurs in the occipital region, is of large size with a broad base, and contains either cerebrum or cerebellum, with a protrusion of either the lateral or the fourth ventricle. Idiocy, microcephaly and hydrocephalus are liable to be present in addition, and most cases are best left alone.

A small meningocele may sometimes be removed and its base sutured.

Hydrocephalus.—An abnormal accumulation of fluid in the ventricles of the brain (internal or intraventricular), or in the subarachnoid space (external or extraventricular). Cerebro-spinal fluid is formed in the choroid plexuses of the ventricles and flows through

the foramina of Majendie and Luschka, situated in the roof of the fourth ventricle, into the subarachnoid space, being then absorbed into the veins, especially those which drain into the superior longitudinal sinus. Accumulation of fluid results from (a) excessive production, (b) interference with circulation, or (c) deficient absorption.

Causes.—(1) Prenatal changes; (2) birth injuries; (3) meningitis, simple or tuberculous; (4) syphilis; (5) tumours.

Varieties.—(1) Congenital; (2) acquired: (a) acute, (b) chronic.

Congenital Hydrocephalus.—The cause is unknown, but the condition is frequently associated with hydramnios. It affects mainly the ventricles (internal), occasionally associated with marked external hydrocephalus. The cranial bones are thinned and separated, the fontanelles of large size; the face appears puny, the eyes are pushed downwards, and the child cannot raise its head. Irritability, mental deficiency, fits, and blindness from optic atrophy are common, few cases surviving to adult life.

Acquired Hydrocephalus.—The acute form is seen in tuberculous meningitis and is usually fatal. The chronic may be external or internal; it results from (a) meningitis—e.g., tuberculous; (b) cerebral or cerebellar tumours; (c) rickets; (d) syphilis.

Diagnosis.—It is of importance to know the type of hydrocephalus present. This may be ascertained by ventriculography, in which air is introduced into the lateral ventricle, skiagrams revealing the outline of the ventricular system.

Treatment.—Any cause, such as syphilis, rickets, tumours or meningitis, must be treated. Ligation of the common carotid arteries one at a time, permanent drainage of the lumbar thecal space into the peritoneal cavity, and reopening of the communication between ventricles and subarachnoid space have all given relief in certain cases, but are of limited value owing to the frequent association of mental changes.

Meningitis.—From a surgical standpoint this usually results from infection of compound fractures of the

skull or by extension from adjacent structures, such as osteomyelitis of the skull, frontal sinusitis or mastoiditis, erysipelas and cellulitis of the scalp, etc., and, rarely, in cases of pyæmia.

Meningitis is divided into **pachymeningitis** or inflammation of the dura, which is usually associated with the formation of a localized extradural or subdural abscess, and **leptomeningitis**, inflammation of the arachnoid and pia mater, which is usually diffuse.

Extradural and Subdural Abscess.—These conditions usually result from compound fractures, or extension of infection from the middle ear. In addition to a high temperature, rigors and signs of compression, such as headache, vomiting and drowsiness, may be present. Œdematous swelling of the scalp (Pott's puffy tumour) is sometimes found in non-traumatic cases. If the abscess is near the motor area, spasm or paralysis of muscles may occur. In subdural abscess the symptoms of compression are more marked than in extradural abscess.

Treatment.—Free removal of bone over the abscess cavity and drainage by a rigid tube are necessary, in addition to treatment of the primary cause.

Diffuse Meningitis (Meningo-encephalitis).—In this the infection spreads rapidly through the whole subarachnoid space, and the cortex of the brain is always involved. High temperature and rigors are common, and the symptoms may be divided into two stages—irritation followed by paralysis.

1. **Stage of Irritation.**—Severe headache and repeated vomiting, delirium, irritability and photophobia are all found; muscular twitchings and convulsions may be prominent in cases affecting the cerebral cortex, whereas, when the base of the brain is involved, retraction of the head and neck, papilloedema and squint are more in evidence.

2. **Stage of Paralysis.**—Drowsiness or coma may be associated with paralysis of the limbs; the pulse is at first slow, later rapid and irregular.

Lumbar puncture reveals the cerebro-spinal fluid under pressure; it may be turbid or frankly purulent, and microscopically shows leucocytes in large numbers.

Treatment.—Sulphanilamide therapy has profoundly modified both treatment and prognosis. Free drainage of the primary source of infection should be combined with repeated lumbar puncture. Continuous irrigation of the subarachnoid space from above downwards has sometimes been successful in cases arising from middle-ear disease.

Abscess of the Brain.

Causes.—1. Extension from neighbouring structures; this is the commonest cause, disease of the middle ear being the usual primary source. The temporo-sphenoidal lobe of the cerebrum and the cerebellum are the usual sites in the proportion of 2 : 1. In most cases infection spreads from the ear by the vessels and lymphatic sheaths, the abscess being separated from the ear by a layer of healthy brain and membranes, but direct spread through the tegmen tympani and membranes may occur. Disease of the frontal, sphenoidal and ethmoidal sinuses or thrombosis of the venous sinuses, particularly the lateral and cavernous, may also give rise to abscess of the brain.

2. Compound fractures and penetrating wounds. The frontal and parietal lobes are the parts usually affected.

3. Pyæmia. Chronic suppuration—*e.g.*, empyema and bronchiectasis—osteomyelitis and certain fevers—*e.g.*, typhoid—are the usual causes.

4. Tuberculosis.

Pathology.—The abscess may be acute, but is more often subacute or chronic, when it has a well-marked wall of fibrous tissue. As it increases in size it causes pressure on the surrounding structures, and spreading œdema may develop with resulting cerebral compression. The abscess may burst into one of the ventricles or into the subarachnoid space.

Symptoms.—1. *Acute Abscess.*—The symptoms are those of acute meningitis.

2. *Subacute and Chronic Abscess.*—In the early stage there is a raised temperature and pulse rate, vomiting and malaise, and if there has been an ear

discharge, this usually ceases. Gradually the picture changes to one of compression: (a) Headache may be localized to the side of the abscess. (b) Temperature is subnormal. (c) Pulse becomes gradually slower, even down to 40 to 50. (d) Cerebration is slow, the patient answering intelligently, but after a long pause; he is lethargic and drowsy. (e) Papilloedema may be present. (f) Vomiting is frequent, without nausea and unrelated to food. (g) Focal symptoms vary with the site of the lesion: in temporo-sphenoidal abscess paralysis of the opposite side and aphasia may result from pressure on the Rolandic and Broca's areas; in cerebellar abscess giddiness, staggering gait and nystagmus are often present. (h) Sudden rise of temperature and pulse, stertorous or Cheyne-Stokes breathing, delirium or coma indicate that the abscess has burst. It may be wise in certain cases to delay operation in order that the abscess should localize itself. Encephalography may be a valuable aid to localization.

Treatment.—The dura mater is exposed over the suspected area, either through a trephine opening or, in cases secondary to middle-ear disease, after a radical mastoid operation; in many cases the dura appears normal, but does not pulsate. It is incised with a fine tenotome or diathermy knife, and the underlying brain explored with a fine trocar and cannula, or a needle and syringe. When pus is found it may be advantageous to repeat the aspiration daily until conditions favour drainage or marsupialization. To effect drainage a pair of sinus forceps is introduced and gently opened to allow evacuation; a rigid drainage tube is inserted into the cavity and stitched to the dura, or it may be marsupialized. In chronic cases, where there is a well-encapsuled collection of pus, modern practice favours complete extirpation of the abscess wall after osteoplastic reflexion of the skull.

Infective Thrombosis of Venous Sinuses.—In practically all cases this is due to extension of infection from neighbouring structures.

Causes.—(1) Middle-ear disease; (2) septic wounds of scalp or orbit; (3) erysipelas, cellulitis, carbuncles

of face or scalp; (4) infections of the frontal, sphenoidal and ethmoidal air sinuses; (5) osteomyelitis of the skull.

The sinus most commonly affected is the lateral (from middle-ear disease); after this the cavernous sinus is most frequently involved. As in infective phlebitis elsewhere, the thrombus is soft and friable, portions becoming detached and forming emboli, which are carried to various parts of the body. Local spread to the skull bones, meninges and brain may cause osteomyelitis, meningitis and brain abscess.

Symptoms.—These are pyæmic in type. High temperature, with remissions and rigors, severe localized headache and frequent vomiting are associated with evidence of secondary abscesses in other parts of the body; the lungs, joints, pericardium and pleura are particularly liable to be affected. The local signs vary with the sinus involved.

1. *Lateral Sinus.*—Localized headache with tenderness over the mastoid process is often present; a tender cord may be felt in the upper part of the neck when thrombosis has spread to the internal jugular vein, and this may be followed by overlying redness and œdema at a later stage.

2. *Cavernous Sinus.*—Exophthalmos, orbital congestion, œdema of the eyelid and chemosis, together with ptosis and squint, owing to paralysis of the ocular muscles, may all be found. These symptoms are unilateral at first, but it is not uncommon for spread to occur to the opposite side.

3. *Superior Longitudinal Sinus.*—Congestion of the scalp and forehead, tenderness over the sinus and epistaxis may be associated with paralysis of one or both lower limbs, especially the distal parts, with extensor plantar reflexes and ankle clonus.

Treatment.—The primary source must be thoroughly dealt with, free drainage being established. In the case of the lateral sinus, the diagnosis should be confirmed by widely opening the sinus and removal of clot until free bleeding occurs; it can be easily checked by packing with gauze. The internal jugular

vein must be tied if possible below any thrombus which it contains, divided, and the proximal end used for syringing through to the mastoid region. In superior longitudinal sinus thrombosis an attempt may be made to establish drainage and to remove infected clot by trephining above the torcular Herophili.

Intracranial Tumours.

Varieties.—1. *Glioma*.—The commonest type, accounting for nearly 50 per cent., of intracranial tumours and occurring in all parts of the brain. The cells vary in shape from round to spindle or spider-shaped; the intercellular substance resembles neuroglia and is apt to undergo cystic changes; hæmorrhages are not uncommon and in most cases there is little attempt at encapsulation. The three main types are: (a) *Astrocytoma*, relatively benign, occurring in the cerebrum and cerebellum in equal proportions. (b) *Spongioblastoma multiforme*, which is very malignant and found mainly in middle-aged adults, almost confined to the cerebral hemispheres. (c) *Medulloblastoma*, affecting the cerebellum, and liable to spread to the region of the roof of the fourth ventricle in children. It is of a highly malignant nature, and very responsive to irradiation (radio-sensitive).

2. *Meningioma*.—This arises from the arachnoid and follows a cruciate distribution at both base and vertex. If calcified they are called psammomas. The majority are not malignant and complete removal is usually possible. Changes in the overlying skull produce characteristic skiagraphic appearances.

3. *Neurofibroma*.—The most common site is the cerebello-pontine angle, arising from the sheath of the auditory nerve (acoustic nerve tumour). The growth is an innocent one, but serious pressure symptoms soon result owing to its situation.

4. *Pituitary Tumour*.—This is usually an adenoma arising in the anterior lobe, several varieties being recognized: (a) *Chromophobe adenoma*, consisting of non-granular cells without eosinophiles, and associated with hypopituitarism. (b) *Chromophile* or

eosinophilic adenoma, with granular eosinophiles, resembling the normal epithelium of the anterior lobe and giving rise to symptoms of hyperpituitarism. (c) Mixed adenoma, mainly chromophobe in type, containing eosinophiles, giving rise to a mixed picture of hyperpituitarism and hypopituitarism (dyspituitarism).

5. *Cranio-pharyngioma, Adamantinoma, Suprasellar Cyst, or Cranio-pharyngeal Pouch Cyst.*—This arises from Rathke's pouch and may form a solid or a cystic tumour.

6. *Bloodvessel Tumour.*—This may be: (a) Angioma of arterial, capillary or venous type, often associated with nævi about the face; or (b) hæmangioblastoma, which is always cystic.

7. *Metastatic Carcinoma or Sarcoma.*—These constitute 4 per cent. of all brain tumours, the primary site being most often in the breast, kidney, skin (malignant melanoma), lung, prostate or stomach. Chloroma also occurs.

8. *Granuloma.*—Although not a neoplasm, this is usually so classified, as it gives rise to identical symptoms and signs. Tuberculoma is occasionally met with in the cerebellum in children. Gumma usually arises from the meninges and may be multiple.

9. *Cholesteatoma*, which may arise quite independently of the middle ear.

Signs and Symptoms.—1. *Focal.*—These vary with the situation of the tumour (see Fig. 31). (a) Motor area of cerebral cortex: Jacksonian epilepsy, followed by localized paralysis. (b) Subcortical area: Localized paralysis without preceding spasms. (c) Broca's area: Motor aphasia, occasionally nominal aphasia, word-blindness or jargon aphasia. (d) Frontal lobe: Tremor, epileptic fits, loss of memory, subtle moral changes. (e) Parietal lobe: Aphasia, alexia, astereognosis, quadrantic visual defects. (f) Temporal lobe: Word deafness. 'Uncinate' fits when the lesion affects the uncinate gyrus. (g) Occipital region: Homonymous hemianopsia; the macular area, however, is spared. (h) Cerebellum: Inco-ordination, vertigo and nystagmus. Hydrocephalus in children:

'Cerebellar' fits. (i) Cerebello-pontine angle: Cerebellar signs, with lesions of cranial nerves, especially the facial and auditory, in addition.

2. *Due to raised Intracranial Pressure.*—(a) Headache. This may be diffuse or localized to the side of the tumour. It is often intense and paroxysmal except in frontal tumours. (b) Vomiting without antecedent nausea, sudden and not related to food. (c) Drowsiness and apathy, with delayed cerebration. (d) Subnormal temperature. (e) Papillœdema, choked disc, or optic neuritis may be at first more

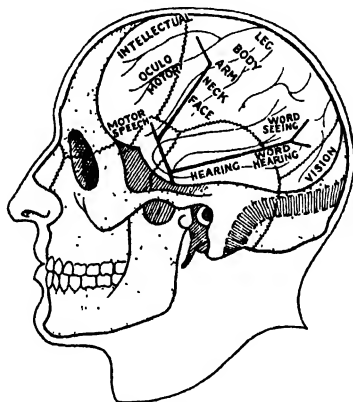


FIG. 31.—CEREBRAL LOCALIZATION.

marked on the side of the tumour. The edges of the disc are obscured, the retinal veins congested and tortuous, and optic atrophy may follow, leading to blindness. (f) Mental or psychic changes, often transitory, may occur in the early stages. Coma, stertorous or Cheyne-Stokes breathing, slow pulse and pupil changes are found in the later stages of cerebral compression.

3. *Due to Pituitary Tumours.*—(a) Hyperpituitarism produces overgrowth of all parts in young people (gigantism), relative overgrowth of the skull, spine

and distal parts of the limbs in adults (acromegaly). (b) Hypopituitarism in children results either in Fröhlich's syndrome in which sex infantilism is combined with generalized increase of subcutaneous fat and increased sugar tolerance, or Lorain's disease, the child being dwarfed and having a fine hairless skin. In adults, sexual desire and power are lost; in females, amenorrhœa is common and the basal metabolism is lowered. (c) Pressure symptoms may occur at any stage, and one of the most important is visual disturbance. Pressure on the optic chiasma or tract results in some form of hemianopsia, either bitemporal or homonymous, and optic atrophy and blindness may follow.

Diagnosis.—Early and repeated systematic examination of the central nervous system is of great importance, and should be supplemented in doubtful cases by (a) skiagrams of the skull, which may show enlargement of the sella turcica in pituitary tumours; erosion of the clinoid processes, and calcification of the cyst wall (71 per cent.) in cranio-pharyngiomas; or erosion, spicule formation, diffuse thickening of the skull and enlargement of the meningeal channels in meningiomas, together with calcification in the tumour. (b) Perimetry. This may disclose unsuspected changes in the fields of vision. (c) The pressure, chemistry and cytology of the cerebro-spinal fluid may afford valuable diagnostic data. (d) Ventriculography. The lateral ventricle is punctured, the cerebro-spinal fluid replaced by air, and skiagrams may show deformation of the ventricles. (e) Encephalography, in which the air is introduced by the spinal route, is less valuable than ventriculography. (f) Electro-encephalography. (g) Arteriography. A radio-opaque fluid is injected into the carotid artery and skiagrams are taken immediately and at short intervals. Cerebral aneurysms, etc., are revealed.

Treatment.—In many cases (meningiomas, pituitary and suprasellar tumours) complete removal is often possible; in others, incomplete removal, combined with subsequent irradiation, prolongs life and alleviates suffering. In the remainder, decompression followed

by irradiation is of value. Local anæsthesia, sometimes combined with intratracheal nitrous oxide and oxygen, careful attention to hæmostasis, and electro-coagulation are all of great importance in operations for the removal of intracranial tumours. Reflection of an osteoplastic flap of the skull provides the best means of approach.

Hernia Cerebri.—A protrusion of brain substance through an acquired opening in the skull, and always associated with an increased intracranial pressure. It may follow decompression operations or compound fractures. At first the herniated portion pulsates, but later adhesions to the scalp form and sloughing of the brain may follow.

CHAPTER XXIV

AFFECTIONS OF THE LIPS AND JAWS

THE LIPS

Hare-lip.—A congenital fissure of the upper lip which may involve the soft tissues only (pre-alveolar), or extend through the alveolus to the palate (post-alveolar).

Varieties.—The fissure may be *complete* or *incomplete* according to whether the nostril is involved or not; *simple* if of soft parts only, *alveolar* when the bone is involved, *complicated* when a cleft palate is present in addition. It may be *unilateral*, in which case the left side is involved twice as often as the right, or *bilateral*, in this instance usually associated with a complete cleft of the palate. The central part of the lip (prolabium) and the underlying bone (os incisivum or premaxilla) may be normal in position, but in the more severe clefts are frequently displaced forwards, forming an appendage at the end of the nose. In all cases the nostril on the affected side is broad and flattened. Heredity has a marked influence, and spina bifida and talipes may also be present.

Effects.—Feeding may be interfered with and, later,

speech is affected, while the disfigurement tends to increase. The best time for operation is from six to twelve weeks—*i.e.*, before the teeth begin to erupt.

Treatment—1. *Single Hare-lip*.—Rose's operation: The lip is thoroughly dissected up from the maxilla and alveolus on each side. The edges of the gap are then pared, so as to leave a concave surface on each side, taking care to include the apex and to extend the incision into the nostril. Special care must be taken to approximate accurately the red margins of the lip and to ensure the preservation of the labio-alveolar furrow, if necessary using Thiersch grafts. The Blair-Mirault operation: In this a flap of the red margin from the outer side of the cleft is stitched to the bevelled-off inner side. In single and particularly in double post-alveolar hare-lip, plastic operations to restore the contour and symmetry of the nares are usually required.

2. *Double Hare-lip*.—If the premaxilla retains its natural place, the labial clefts are alone dealt with. If, as is usual, it projects forwards it must not be removed, but pared down or, if possible, replaced, but in any case the prolabium is saved. As a rule, it is better not to remove the premaxilla, for if this is done the lip falls in in an unsightly manner; on the other hand, if it is retained, firm union may not occur, and the teeth erupt obliquely backwards. If it is decided to conserve it, the bone is pushed backwards after detaching the prolabium; if this proves impossible, the septum is divided, and the bone is then forced back. When the gap is too small to receive the premaxilla, its size should be reduced by gouging out the partly developed teeth. The edges of the premaxilla and alveoli should be pared, and the cut surfaces of the mucous membrane then sutured.

Ulcers of the Lips—1. *Simple*.—'Cracked lips' are painful fissures following exposure to cold.

2. *Herpetic*.—A localized crop of vesicles appears on one or other lip, usually limited to one side, becoming pustular and scabbed. It is frequently associated with a common cold, or with other infections involving the respiratory tract.

3. *Syphilitic*.—(a) Primary chancre: Usually a smooth flat ulcer without much induration, but with extensive infiltration around; the submaxillary lymph glands soon become enlarged and sometimes matted. Infection is conveyed by kissing, pipe-smoking or drinking from contaminated vessels, the upper lip being usually involved. (b) Secondary stage: Mucous patches are common on the inner sides of the lip and at the angle of the mouth. (c) Tertiary stage: Serpiginous ulceration, gumma formation and diffuse infiltration with thickening from fibrosis may all occur. (d) Inherited syphilis: Mucous patches and fissures are common and may leave radiating cicatrices at the corners of the mouth (rhagades).

4. *Malignant*.—These are much commoner on the lower lip and practically always found in men.

5. *Tuberculous*.—(a) Persistent cracks and fissures are seen in tuberculous children and young people, associated with thickening and enlargement of either lip (strumous lip). (b) Lupous ulcers may be found involving either lip.

Innocent Tumours.—1. *Nævus*.—This is a common condition and may be either capillary or cavernous.

2. *Papilloma*.—Is usually found on the lower lip near the angle of the mouth and may give rise to malignant disease.

Mucous Cyst.—This forms an elastic rounded swelling on the inner aspect of the lip, usually the lower; it contains glairy mucoïd fluid, may be translucent, and sometimes follows trauma.

Carcinoma.—The great majority of cases are found in middle-aged or elderly men, often of the agricultural working classes. The lower lip and the angle of the mouth are the parts most often involved.

Pathology.—The growth is a squamous-celled carcinoma and cell-nest formation is usually well marked. It may begin as (a) an indurated fissure, which gradually extends and ulcerates; (b) a warty growth with early ulceration; (c) an indurated nodule; or (d) a thickened area of epithelium. Local extension with spread to the lymph glands, first of the submental and submaxillary regions, and later of

the deep cervical group, takes place relatively slowly. The glands are at first enlarged, hard and discrete, but subsequently matting is found, followed by cystic degeneration and ulceration. Visceral deposits are rare. When death occurs, it is due to fungation of the secondary growths in the neck and exhaustion from pain and sepsis, or secondary hæmorrhage from erosion of bloodvessels.

Diagnosis.—Any area of induration or infiltration of the lip should be regarded with suspicion, and in case of doubt a portion should be removed for microscopical examination. Primary chancre may cause confusion, but usually develops more rapidly with early infiltration of the glands.

Treatment—1. *Primary Growth.*—The choice is between wide and local excision, telerradium and near-distance low-voltage X-ray therapy with the Chaoul type of tube.

2. *Glandular Areas.*—These should always be dealt with whether apparently involved or not. Block dissection of both submaxillary regions through a wide collar incision should be performed; the contents of the submental and of both submaxillary triangles are removed in one piece, together with the superficial and deep fascia as far out as the carotid sheath on both sides. Operation is contra-indicated when the glands are extensively matted or adherent to skin or deep structures, and in these irradiation should be carried out: in a few, marked improvement follows, and operation is then possible; in the majority temporary shrinkage or even disappearance is followed later by further glandular involvement and extension of the disease.

Macrocheilia.—Hypertrophy of the lip occurs in three forms:

1. *Congenital.*—This is due to a lymphangiectasis and usually involves the lower lip.

2. *Acquired.*—The result of chronic lymphangitis from toxic absorption through cracks and fissures; it is found in children and adolescents of tuberculous diathesis, usually affecting the upper lip.

3. *Syphilitic.*—Diffuse infiltration, usually of the

lower lip in adults, occurs in the tertiary stage, the lip becoming enlarged and indurated.

Macrostoma, microstoma, oblique facial cleft, and mandibular cleft are all rare congenital abnormalities which may need plastic repair.

The Gums and Alveolar Processes.

Alveolar Abscess.—This results from spread of infection from a carious tooth, usually via the pulp chamber and apical foramen. Pus may burst through the gum (gumboil), or spread under the periosteum, leading to necrosis of the jaw; in the upper jaw the septic process may extend to the maxillary antrum, in the lower jaw to the soft tissues overlying the mandible or to the submaxillary region, in which case the abscess may burst, leaving a sinus which persists until the tooth or sequestrum is removed. Pain and swelling of the face, often with trismus, are usually severe and toxic absorption is a marked feature.

Treatment.—The carious tooth should be removed as soon as possible, and in most cases the abscess discharges into the mouth and subsides, frequent antiseptic mouth-washes being employed. When there is an external fluctuating swelling, this usually needs drainage through the skin in addition. When a sequestrum has formed, it may require removal at a later date.

Pyorrhœa Alveolaris.—An inflammatory condition of the gums, which are swollen and œdematous, especially at the margins, resulting in pockets which extend along the roots of the teeth. Bleeding readily occurs, and pus can be squeezed out by pressure along the alveolar margin. In time, atrophy of the gums and alveolar process occurs, the teeth become loosened and fall out. The condition is often preceded by excessive deposit of tartar, which favours bacterial growth.

Treatment.—In the early stages removal of tartar and the application of astringents and antiseptics may arrest the disease; if not, removal of the teeth

in the affected area may be called for, to avoid septic absorption and its more remote results.

Dental Cyst.—This always occurs in connexion with a dead tooth or root, and is most commonly seen in the upper molar or bicuspid region. A painless, smooth swelling of the bone is followed by egg-shell crackling; later a rounded, elastic swelling with a sharp bony margin can be palpated. The cyst contains brownish turbid fluid, often shimmering with cholesterin crystals. The cause is thought to be chronic sepsis leading to proliferation and degeneration of embryonic remains of the enamel organ.

Treatment.—The cyst is opened, the dead tooth or stump and as much of the cyst wall as possible removed, the cavity swabbed out with pure carbolic acid and allowed to granulate.

Epulis.—A tumour growing from the periosteum of the alveolus or the periodontal membrane. Two varieties—simple and myeloid—are recognized.

1. **Simple Epulis.**—This forms a firm, smooth or lobulated mass, covered by mucous membrane. It involves more often the lower alveolus, usually on its outer aspect but also spreading between the teeth and appearing medially. It is usually associated with caries of the adjacent teeth. Microscopically it may have the characters of a fibroma or fibro-sarcoma.

Treatment.—The growth should be removed, together with any carious teeth or stumps in the neighbourhood; if recurrence follows, free excision of the alveolus in the region of the tumour must also be performed.

2. **Myeloid Epulis.**—A benign, giant-cell tumour (osteoclastoma) may originate in the alveolus, forming a soft, rapidly growing, maroon-coloured growth which soon ulcerates.

Treatment.—Free local excision of the growth, together with the portion of the alveolus from which it arises, should be followed by prophylactic irradiation.

Carcinoma and Sarcoma.—The former is squamous celled and soon infiltrates the alveolus; in the upper jaw, extension to the antrum may follow, forming a 'creeping,' 'boring' or 'burrowing' epithelioma.

Sarcoma may be of the round- or spindle-celled type. In early cases free local excision, in later cases irradiation, should be carried out.

THE JAWS

Fractures—1. **Maxilla**.—Broken by direct violence and nearly always a compound fracture. Treatment consists in frequent mouth-washes, and union occurs readily, though necrosis may ensue. Septic pneumonia is the main danger.

2. **Mandible**.—May be fractured by direct or indirect violence, commonly the former. (1) The most usual situation is at the weakest part—*i.e.*, in the neighbourhood of the canine tooth. The alveolus is usually involved, and the fracture is then always compound; laceration of the gums, irregularity in the line of the teeth, abnormal mobility and crepitus are usually present. (2) If the fracture is at the angle or in the vertical ramus, there may be little displacement. (3) If the fracture is through the neck of the condyle, the latter is drawn forwards by the external pterygoid muscle, and the body of the mandible is displaced to the fractured side.

When the fracture is compound, septic pneumonia, osteomyelitis, or pyæmia may follow.

Treatment.—1. If there is little displacement, the jaw can be efficiently fixed by a four-tailed bandage, which supports the mandible. Two of the tails are tied over the vertex, two just above the occipital protuberance, and the two upper ends are then tied to the lower to prevent slipping. The patient should be fed by fluids for four to five weeks, and the mouth frequently washed out. A moulded gutta-percha, poroplastic, or celluloid splint may also be used.

2. If there is much displacement, Hammond's wire dental splint may be used. It consists of a wire frame which fits over the whole of the lower teeth, to which it is fixed by intermediate encircling wires. Kingsley's splint is a vulcanite one, moulded over the lower teeth, but various types of metal splint are now preferred. Gunning's interdental splint, modified

so as to permit an open bite, is the most generally useful for gunshot fractures. Ununited fractures are best treated by a graft taken from the ilium.

Necrosis.—This may arise from (a) dental caries and alveolar abscess; (b) compound fractures; (c) dental extractions; (d) exanthemata; (e) mercurial poisoning; (f) phosphorus poisoning; (g) tertiary syphilis; (h) actinomycosis; (i) tuberculosis; (j) radium.

Symptoms.—Severe pain and swelling of the face, trismus, raised temperature and foul breath are followed by an abscess, which may burst into the mouth or on to the face or neck, leaving a sinus which persists. Bare bone may be felt at the bottom of the sinus and skiagrams disclose a sequestrum.

Treatment.—Hot mouth-washes and fomentations externally should be combined with general treatment. Free incision inside the mouth should be carried out as soon as pus is suspected, followed by frequent irrigation until the sequestrum is loose. Removal of the sequestrum is usually needed and should be undertaken from within the mouth if possible.

Actinomycosis.—This is an unusual infection of the jaws, usually the lower, and occurs through a carious tooth; chronic osteomyelitis results with supuration and necrosis of the mandible. As elsewhere, the characteristic features are the widespread induration with multiple sinuses, and discharge which may contain granules, sometimes of a yellow colour. The disease may spread to the lung.

Neoplasms.—1. **Fibroma.**—This is usually met with in the form of a simple epulis, which has been already described.

2. **Osteoma.**—Not common, but may be found growing into the maxillary antrum.

3. **Benign Giant-Cell Tumour.**—In addition to the myeloid epulis already described, this growth is found in the body of the mandible, where it may give rise to expansion and egg-shell crackling. Treatment by curettage, swabbing with pure carbolic acid and packing the cavity should be followed by prophylactic irradiation.

4. **Ewing's Tumour.**—This may originate in the mandible, either alone or in association with foci in other bones.

5. **Fibro-sarcoma.**—Resembles extraperiosteal fibro-sarcoma in other bones, and forms one type of epulis, usually termed simple but in which local excision is liable to be followed by recurrence.

6. **Osteogenic Sarcoma.**—Is rare in the jaws.

7. **Metastatic Carcinoma and Sarcoma.**—Both occur.

8. **Odontoma.**—This arises in connexion with the tooth germs; seven varieties are described:

(a) *Epithelial (Fibro-cystic Disease).*—This type is derived from remnants of the enamel organ, and is usually found in individuals about the age of twenty years, occurring ten times more frequently in the lower jaw than in the upper. It forms a tumour, often of large size and reddish in parts, which on section consists of large numbers of small cysts containing mucoid fluid, separated by fibrous or osseous septa. Microscopically the cysts are lined by cubical or columnar epithelium. The more solid adamantinoma is probably of similar origin. Treatment consists in radical extirpation of the affected portion of the jaw, followed if necessary by bone grafting. Less extensive operations may succeed in some cases.

(b) *Follicular (Dentigerous Cyst).*—This arises from the dental sac around an unerupted tooth, and causes expansion of the jaw. At first the tumour is hard and solid, later egg-shell crackling and fluctuation may be detected, and in some cases, owing to infection from a neighbouring tooth, a sinus may form discharging pus. It may be found in the upper or lower jaw, more commonly the latter, and in the molar region; it usually but not invariably affects young people.

(c) *Fibrous.*—This also arises from the dental sac, which becomes thickened, an unerupted tooth lying in a mass of fibrous tissue. This variety is rare in human beings.

(d) *Cementome.*—In this the dental sac becomes calcified and ossified. This also is a rare variety.

(e) *Compound Follicular.*—Arises from the fusion of several adjacent dental sacs, and results in a dentiger-

ous cyst containing a large number of badly formed teeth.

(f) *Radicular*.—Is rare and of small size. A solid tumour composed of dentine and cementum is found, growing from the root of a tooth.

(g) *Composite*.—A solid hard tumour, which may be of large size and resembles an ivory osteoma, may occur in either upper or lower jaw. It has no connexion with the bone, and is easily removed after opening the cavity in which it is contained. It consists of a fused mass of dentine, enamel and cementum.

Diagnosis.—In most cases this can be made by noting the associated absence of one or more permanent teeth, or the persistence of the milk teeth. Skiagrams may disclose an unerupted tooth embedded in the swelling.

Leontiasis Ossea.—A rare disease commencing in young adults and of slow progress; it may be due to chronic infection. It affects the cranial and facial bones, and the masses of newly formed soft spongy bone lead to a repulsive appearance. The orbit, antrum and cranium may be involved, resulting in exophthalmos, nasal obstruction, neuralgic pain and coma. No treatment is of any avail.

Maxillary Sinusitis or Antritis.—Inflammation of the antrum of Highmore or the maxillary sinus is usually secondary to (a) acute rhinitis; (b) dental caries, affecting the bicuspid or first or second molar tooth; (c) disease of the frontal or ethmoidal sinus. It occasionally follows injury, or direct infection after bathing in polluted water.

Signs and Symptoms.—In acute cases, severe throbbing pain over the antrum and raised temperature; neuralgic pain along the branches of the trigeminal nerve may also occur, and there is usually marked tenderness on pressure over the antrum. In chronic cases the main symptom is a purulent nasal discharge, sometimes with an intractable cough; the discharge is usually intermittent, often unilateral, and may be offensive. When it ceases, headache, local pain and swelling may appear.

Diagnosis.—The intermittent discharge of pus, possibly induced by certain positions of the head, is almost certain proof of disease of one or other accessory nasal sinus. Pus may be seen coming from under the anterior end of the middle turbinate bone. Transillumination of the antrum and X-ray examination may be of great help by disclosing increased density on one or other side. Finally, puncture of the antrum with Lichwitz's trocar and cannula through the inferior meatus, followed by irrigation, will decide the diagnosis.

Treatment.—Acute cases need frequent irrigation, which is carried out through the inferior meatus; the inner wall of the antrum is punctured below the inferior turbinate bone, after applying cocaine, and irrigation carried out through the cannula. Chronic cases may need operative treatment to secure free drainage, which is obtained by removing the bone separating the antrum from the anterior part of the inferior meatus; when polypi are present, it may also be necessary to remove the anterior wall of the antrum above the canine and molar teeth (Caldwell-Luc operation) to obtain free access to all parts of the cavity. The polypi are removed, but the mucous membrane must not be scraped away. Relapses are so common after operation that conservative treatment is usually wisest.

Malignant Tumours of the Maxillary Antrum.—The following varieties are found:

1. *Carcinoma.*—This may be of several types: (a) Cylindrical-cell or adeno-carcinoma, the common form, which grows rapidly, infiltrating the bone and recurring quickly after operation. (b) Papillary, originally of slow growth, but later becoming more malignant. (c) Round-cell, which is frequently mistaken for a sarcoma owing to the absence of alveolar structure. (d) Basal-cell, of relatively slow growth, but after incomplete removal may recur and invade both the bone and lymph glands. (e) Squamous-cell is rare, arising from metaplasia of the epithelial cells of the mucous membrane.

2. *Adamantinoma.*—This arises from paradental

epithelium, and the microscopical appearances vary considerably; squamous or columnar cells may be prominent, and in some cases there are large areas of spindle or round cells simulating sarcoma. It usually forms a solid tumour of slow growth which recurs locally after removal, invades the orbit and nasopharynx, but seldom infiltrates lymph glands except in recurrences.

3. *Sarcoma*.—Angio- and myxo-sarcoma arise from the lining of the antrum. Fibro-sarcoma has often been described, but osteogenic sarcoma is rare.

Signs and Symptoms.—These may be divided into three stages:

(a) *Latent Stage*.—Aching or neuralgic pain in the jaw, purulent discharge from the nose, epistaxis, polypoid growths near the opening of the antrum, and loosening of the teeth all call for thorough investigation by skiagrams and transillumination.

(b) *Deformity Stage*.—Swelling of the walls of the antrum may cause bulging of the cheek, displacement of the eyeball with exophthalmos, nasal obstruction and epiphora, or deformity of the palate.

(c) *Invasion Stage*.—Infiltration of the walls and adjacent structures results in ulceration, hæmorrhage and fungation into the mouth, nose, orbit, or pharynx; the skull or lymph glands may also be invaded.

Treatment.—The antrum is freely opened by reflecting the mucous membrane of the mouth in the region of the canine fossa, removing the anterior wall of the maxilla, and also, if necessary, the lateral wall of the nose and a portion of the palate. In a few early cases the growth may then be completely removed, but in the majority diathermy, repeated at intervals and combined with irradiation by radium or X-rays, gives the best results.

Temporo-mandibular Joint.

Dislocation.—Results from excessive opening of the mouth, such as yawning, dental extractions, or a blow on the chin while the mouth is widely open. The condyle slips forward over the eminentia

articularis into the zygomatic fossa. The dislocation may be unilateral or bilateral. The mouth remains widely open and the jaw projects; mobility is impaired, and the saliva dribbles. The condyle can be felt in front of its natural position, while behind it is an unnatural hollow. If unilateral, the jaw is displaced to the sound side.

Treatment.—Reduction is easy. The lower molar teeth are pressed firmly downwards by the surgeon's thumbs, protected by a thick fold of towel in case the patient bites; this frees the condyle and the chin is then raised by the fingers. The condyle then slips back into place and the jaw is kept at rest by means of a four-tailed bandage for a few days.

Acute Arthritis.—This may be due to gonorrhœa, acute infective fevers, pyæmia or direct extension from middle-ear disease through the tympanic plate. Suppuration may be followed by ankylosis, for which excision of the condyle may have to be performed.

Osteo-arthritis.—This is not uncommon, and frequently symmetrical. The articular and inter-articular cartilages become worn away, the glenoid cavity flattened, the condyle eburnated and enlarged. Forward displacement of the mandible may result in a prominent or deviated chin. Pain is felt especially in wet weather, with creaking and difficulty in opening the mouth. If medical treatment fails, the condyle must be excised.

Tuberculous Arthritis and Rheumatic Synovitis.—These are both rare.

Internal Derangement (*Locking or Clicking Jaw*).—This results from laxity of the interarticular cartilage, which gets nipped between the condyle and the eminentia articularis when the mouth is opened. There is pain, locking of the jaw, and marked clicking in the region of the joint when the mouth is opened. Spontaneous recovery sometimes occurs, but in others the cartilage must be excised.

Trismus.—Inability to open the mouth may be due to a number of causes:

1. Fibrous or bony ankylosis of the temporo-mandibular joint following arthritis.

2. Bony deformity resulting from fractures, tumours or cysts of the mandible.

3. Cicatricial contraction of the soft tissues after burns, lupus, operations or cancrum oris.

4. Spasm of muscles due to reflex irritation from dental caries, an unerupted wisdom tooth, hysteria or tetanus.

5. Inflammatory conditions such as parotitis and alveolar abscess.

6. Malignant growths involving the cheek and fauces.

Treatment.—Excision of the condyle is needed in cases of fibrous ankylosis; when bony ankylosis or cicatricial contraction is the cause, removal of a wedge of bone, with its apex forwards, from the region of the angle (Esmarch's operation) is the best course, leaving a false joint in this situation.

CHAPTER XXV

AFFECTIONS OF THE MOUTH, SALIVARY GLANDS AND PALATE

THE MOUTH

Stomatitis.—Inflammation of the mucous membrane of the mouth is common, especially in children and artificially-fed babies.

Varieties—1. *Catarrhal.*—This results from improper feeding, dyspepsia, debility after infectious fevers or during the course of the exanthemata, such as measles and scarlatina. In adults, carious roughened teeth, excessive smoking, badly-fitting dentures, scalds and irritation from food are often responsible. Patches of hyperæmia and swelling may become confluent and painful superficial erosions and ulcers follow; secretion of mucus is increased. The treatment consists in the removal of any cause, attention to the general health and the use of antiseptic mouth-washes such as liq. thymol. co. or peroxide of hydrogen.

2. *Aphthous*.—This is due to bad feeding in infants, and appears as small, whitish patches which later become ulcerated and painful.

3. *Due to Thrush*.—Resembles the last variety, occurring in infants and debilitated adults, sometimes after surgical operations. It is due to a fungus, *Oridium albicans*, which is found in sour milk.

4. *Gangrenous (Cancrum Oris)*.—See p. 193.

5. *Mercurial*.—This is rare nowadays, but may follow a single dose of mercury in a patient with dental caries and sepsis, or one who smokes to excess. The gums become swollen and tender, bleed readily on pressure, and in severe cases the teeth may become loosened and necrosis of the jaw follows. Factor of the breath and salivation are marked. The mercury should be discontinued, mouth-washes of potassium chlorate and dilute hydrochloric acid used, and saline purgatives given.

6. *Syphilitic*.—See p. 34.

Stomatitis may occur in diphtheria, corysipelas and other infections.

THE TONGUE

Congenital Abnormalities—1. *Macroglossia*.—The tongue is enlarged in all directions and protrudes from the mouth; indentation by the teeth and ulceration are present, and it is purplish and dry, sometimes with small vesicles on the surface. The underlying cause is in most cases lymphatic dilatation, regarded by some as a type of lymphangioma with secondary œdema and overgrowth of fibrous tissue. Recurrent attacks of inflammation aggravate the condition, and sarcoma may supervene. In rare cases it is due to neurofibromatosis affecting the nerves of the tongue. Treatment consists in excision of a V-shaped portion and suture of the raw surfaces.

2. *Tongue Tie*.—The frænum is short, the tip of the tongue depressed and cannot be protruded owing to the apparent fixation to the floor of the mouth. The condition is often thought by parents to be responsible for the child being backward in talking

and for lisping; this is not the case, the only result being occasional difficulties in suckling during the first few months. For this reason only it is occasionally justifiable to snip the frænum with scissors, but care must be exercised not to divide it too freely, otherwise tongue-swallowing may result.

3. *Abnormal Mobility*.—This is usually combined with increased length and has resulted in asphyxia from the tongue falling back into the pharynx.

4. *Complete or partial absence, hemiatrophy, bifid or split tongue*, and *ankyloglossia* are all rare. In the last of these the tongue is bound to the floor of the mouth.

Wounds.—These are usually caused by the teeth, being common in children as the result of falls, also in epileptics during fits, or from foreign bodies such as a pipe. Hæmorrhage may be profuse and necessitate securing the bleeding points with artery forceps; in most cases insertion of catgut sutures is all that is needed. Occasionally, especially in cases of secondary hæmorrhage, ligature of the lingual or external carotid artery may have to be performed.

Glossitis.—Inflammation of the tongue occurs in the following forms:

1. *Acute Superficial*.—This occurs as part of a generalized acute stomatitis.

2. *Acute Parenchymatous*.—Arises after penetrating and septic wounds, bites and stings of insects, exanthemata, and the administration of mercury. When infection is present the responsible organism is usually the *Streptococcus pyogenes*. The tongue is painful, swells rapidly and protrudes from the mouth. Salivation is marked and speech, deglutition and respiration are interfered with; urgent dyspnœa may occur from extension of œdema to the glottis. The cervical glands are enlarged and the temperature raised. The condition is sometimes restricted to one side of the tongue (hemiglossitis). Most cases end in resolution, but suppuration and gangrene may ensue.

Treatment.—(a) Removal of any cause, antiseptic mouth-washes, potassium chlorate internally, and

saline purges. (b) Free incision into the dorsum of the tongue, on either side of the middle line. (c) Tracheotomy if asphyxia is threatened.

3. **Chronic Superficial.**—This type may be found in conjunction with a similar condition affecting the mucous membrane of the cheeks and lips. The causes are: (a) Syphilis in the tertiary stage is the most common. (b) Smoking in excess. (c) Sepsis in relation to the teeth, which are often carious and rough. (d) Spirits. (e) Spices and hot food in gouty subjects who also suffer from chronic dyspepsia. The condition usually affects men between the ages of forty and sixty, is very intractable and liable to be followed by epithelioma (25 per cent.). Five stages are described, several of which may be present together:

(1) Red, hyperæmic patches, due to enlargement and swelling of the papillæ.

(2) White, opaque areas which are raised (leukoplakia or ichthyosis).

(3) Red, smooth patches with loss of the papillæ. The condition may be localized, when it is known as psoriasis of the tongue, or more generalized, producing the 'glazed red tongue.'

(4) Cracks, fissures and ulcers. This is the pre-cancerous stage.

(5) Indurated areas around a fissure indicate the transition to a malignant condition.

Symptoms.—Discomfort and pain are felt after ingesting hot fluids, condiments, and alcohol; speech may be impaired and taste lost.

Treatment.—All sources of irritation should be removed. Smoking, chewing of tobacco, alcohol and condiments should be forbidden, carious teeth removed, and antiseptic mouth-washes employed. Cracks and ulcers may need the application of a weak solution of chromic acid (5 grains to the ounce of water), but on no account should strong caustics be applied owing to the danger of initiating malignant changes. It may be advisable in intractable cases to excise portions of the tongue or to apply radium, either in the form of an applicator or bomb.

4. **Chronic Parenchymatous.**—This is practically

always due to tertiary syphilis, but occasionally results from oral sepsis. Diffuse infiltration with fibrous tissue takes place, the tongue becoming hard and shrunken in parts, with rounded raised areas in others.

5. Chronic Streptococcal.—This is fairly common, and usually found in females and children. Localized patches of hyperæmia and overgrowth of papillæ appear, and the sodden epithelium becomes heaped up; this, in contrast with the smooth denuded areas, produces an appearance of fissuring.

Smoker's Patch.—A red localized area, denuded of papillæ and often covered by a yellowish-white crust on the front of the tongue, is present.

Abscess of the Tongue.—This usually results from infection through an unnoticed abrasion, is found in the anterior part, and subacute or chronic in its development. An indurated, tender mass forms, in which it may be difficult to detect fluctuation.

Sublingual Abscess.—This is usually acute and the result of a punctured wound or of infection of the sublingual salivary or mucous glands in the floor of the mouth. An œdematous swelling appears underneath the tongue, which is pushed upwards and swollen. Extension to the submental region and spreading cellulitis follow, and there is danger of œdema extending to the glottis.

Ulcers of the Tongue.—These may be:

1. *Dental or Traumatic.*—The result of irritation from broken or carious teeth or from tooth plates, and usually found on the edges of the tongue. If neglected, induration may develop and carcinoma supervene. The cause should be removed, when healing rapidly follows unless malignant changes have already taken place.

2. *Dyspeptic.*—These ulcers are shallow and very painful, occurring usually on the dorsum near the tip and associated with dyspepsia.

3. *Tuberculous.*—These are rare, and nearly always secondary to pulmonary or laryngeal tuberculosis, infection occurring from the sputum; they commence as submucous abscesses near the tip or side of the tongue. The ulcers are shallow with undermined

edges and pale granulations in the base. Severe pain is a prominent feature. Excision is the best treatment, but may be contra-indicated owing to advanced pulmonary and laryngeal disease, in which case analgesics such as orthoform or cocaine should be applied before meals.

4. *Lupoid*.—Lupus vulgaris affects the tongue by extension from the face, and results in dense fibrosis with superficial ulceration which slowly spreads. X-ray therapy or radium should be employed.

5. *Frænal*.—These occur on the under surface of the tongue in children, particularly those suffering from whooping-cough.

6. *Herpetic*.—Multiple shallow painful ulcers on the back and sides of the tongue follow bursting of the infected vesicles. The condition may be unilateral and may also involve the cheek. Antiseptic mouth-washes are indicated.

7. *Mercurial*.—These are found in cases of mercurial glossitis.

8. *Syphilitic*.—Ulceration may occur in the primary, secondary and tertiary stages (*vide infra*)...

9. *Carcinomatous* (*vide infra*).

Syphilis of Tongue—1. *Primary*.—A chancre develops, usually near the tip, as an indolent ulcer without much induration, but sometimes with considerable swelling and extensive involvement of the submental and submaxillary lymph glands: these may be matted, although suppuration is uncommon.

2. *Secondary*.—(a) Mucous patches. (b) Shallow snail-track ulcers. (c) Cracks and fissures. (d) Hutchinson's wart—a broad, sessile condyloma on the dorsum of the tongue.

3. *Tertiary*.—(a) Chronic superficial glossitis. (b) Chronic parenchymatous glossitis or diffuse gummatous infiltration. (c) Localized gumma. This is not uncommon in the late tertiary stage, often at about the age of forty; it occurs near the mid-line, usually involving the middle or posterior third of the tongue. Submucous induration and swelling are followed by softening and discharge of necrotic material, leaving an ulcer. The ulcer is oval or round,

deeply excavated, and covered by a yellow slough; the tongue can be protruded, deglutition and articulation are not seriously affected, nor are the lymph glands enlarged. Treatment consists of potassium iodide and mercury, together with simple mouth-washes. Rapid healing follows, leaving a depressed scar.

Black Hairy Tongue.—A rare condition confined to the centre of the dorsum; the filiform papillæ are long and stained black, thus resembling hair. It is due to bacterial action or chemical changes in the food, and often symptomless, but the condition is sometimes associated with dyspepsia or oral sepsis.

Innocent Tumours.—Papilloma, angioma, endothelioma, adenoma, fibroma, lipoma and plexiform neurofibroma are all rare.

Dermoid Cyst.—This occurs in the mid-line of the tongue, mainly in young adults; it usually projects under the chin, sometimes in the floor of the mouth, and forms a smooth, rounded swelling in which fluctuation may be detected. Removal should be carried out through an incision below the chin.

Thyroglossal Tumour or Lingual Thyroid.—This appears as a painless, round, elastic tumour bulging from the dorsum of the tongue near the foramen cæcum. It is dark red or purple in colour, has large vessels on its surface and may become cystic. Rapid increase in size, causing difficulty in swallowing and speech, may result from hæmorrhage into the tumour. Serious bleeding may arise from its surface.

Carcinoma.—Cancer of the tongue is a common condition, mainly affecting men between the ages of forty and sixty. The growth, when it involves the anterior two-thirds, is a squamous-celled carcinoma, in which cell-nest formation can usually be found, but a transitional squamous-celled variety occurs particularly in the posterior part of the tongue—the former is radio-resistant, the latter radio-sensitive. Predisposing causes are: (a) chronic superficial glossitis, (b) excessive smoking or chewing of tobacco, (c) irritation from a carious or sharp tooth. The Wassermann reaction is positive in a large number of

The growth may arise as: (a) An ulcer near the side of the tongue, often at the junction of the middle and posterior thirds. (b) A crack, fissure or depressed scar on the dorsum. (c) A warty growth with infiltration of the base. (d) Submucous infiltration. (e) An ulcer on the floor of the mouth. (f) An extension from the tonsil, gum, or floor of the mouth.

Signs and Symptoms.—Early signs are induration and infiltration of a localized area of the tongue; if ulceration is present, the edges are hard and raised, the base indurated and foul, bleeding readily. Later, the breath is offensive, salivation profuse, and movements of the tongue painful and limited. Pain is often a prominent feature, at first localized to the tongue and later radiating to the ear and side of the head. Dysphagia may be an early symptom when the growth affects the posterior third, but before this changes in the voice may be obvious. Lymph-gland invasion soon follows as a rule, the glands affected being those in the submental and submaxillary regions in growths of the anterior part of the tongue, at the angle of the jaw (subparotid) when the posterior third is involved. The deep cervical glands are frequently infiltrated, particularly one near the bifurcation of the common carotid artery. At first the glands are enlarged, hard and discrete, but matting and adhesion to surrounding structures soon follow, and cystic degeneration and ulceration are not uncommon. If the growth in the tongue is strictly confined to one side, lymph-gland invasion is generally unilateral; both sides of the neck are soon affected if the growth commences near the mid-line of the tongue or in the floor of the mouth. It must be noted that some of the glandular enlargement in the early stages may be the result of septic infection.

Cachexia is a marked feature in the later stages, and is due to a combination of pain, septic absorption, inability to eat and sleeplessness. Death usually results in twelve to eighteen months from exhaustion, secondary hæmorrhage or broncho-pneumonia.

Diagnosis.—It is important to remember that

all chronic ulcers, fissures, etc., of the tongue are potentially malignant, and the slightest induration of the surrounding tissues justifies removal of a portion for microscopical examination. The fact that a positive Wassermann reaction is present should not be allowed to influence this course of action in any way. Many cases of carcinoma will benefit temporarily by antisyphilitic treatment, but valuable time will be lost, during which metastases may occur.

Treatment.—The first step is the removal of carious teeth and the use of antiseptic mouth-washes to reduce oral sepsis to a minimum.

1. *Primary Growth.*—The choice here lies between operation and radiotherapy. In early cases affecting the anterior two-thirds of the tongue, diathermy excision should be performed, the growth, together with a wide margin of healthy tissue in all directions, being removed. In all other cases radium should be employed, either in the form of needles or radon seeds inserted around the growth or by telerradiation, but sometimes the two methods may need to be used consecutively in order to destroy residual foci which have resisted telerradiation. The choice of method depends upon the situation and extent of the growth, the tolerance of the patient and the friability of the tissues. The object sought is to destroy all malignant cells in the one course of treatment. If this is not achieved, any residual growth is found to be more resistant to the action of radium.

2. *Regional Nodes.*—(a) Block dissection should be carried out when the lymph nodes are either non-palpable or are palpable but mobile. In the former group some surgeons prefer a more limited operation. A quadrilateral flap of skin only is reflected from the middle line in front to the anterior border of the trapezius behind. The platysma, deep fascia, sternomastoid muscle, internal jugular vein, submaxillary gland, and all cellular tissue, lymphatic glands and vessels are removed in one piece from the root of the neck to the base of the skull. This operation should be performed on the side of the neck corresponding to

the primary growth in the tongue. In cases in which the growth has spread up to or across the middle line bilateral operation is necessary, the second side being operated upon several weeks after the first, a more limited excision, preserving the internal jugular vein, being carried out. When nodes are both enlarged and fixed, recourse must be made to teleradiation or to deep X-ray therapy.

(b) Teleradiation or high, medium and low voltage X-ray therapy may prove of value in carcinoma of the tongue at certain sites and at certain stages. It will sometimes be found that some apparently inoperable cases become operable after a course of irradiation.

3. *Palliative Treatment*.—Opiates are usually needed, and in some intractable cases of neuralgia excision of a portion of the lingual nerve is required or trigeminal nerve blocking with alcohol. Ligation of the external carotid may be necessary for severe secondary hemorrhage.

Cancerophobia is common, especially in women in connexion with prominent circumvallate papillæ and other trivial lesions. Reassurance is necessary.

SALIVARY GLANDS

Parotitis.—Inflammation of the parotid gland occurs in the following three forms:

1. **Epidemic (*Mumps*)**.—A specific infectious disease, usually affecting children. Both parotid glands are involved, one a few days after the other, and the submaxillary and sublingual glands are often affected in addition. The gland becomes swollen, painful and tender, mastication is interfered with and the temperature raised. The swelling subsides after about a week, but in adults inflammation of the testicle, ovary, breast and pancreas are not uncommon. Atrophy of the testicle often follows, but fortunately the condition is generally unilateral and sterility is exceptional.

Treatment.—The patient should be kept in bed on a light diet, with liberal fluids and saline purges. Isolation is necessary for three weeks.

2. **Simple.**—This is usually a mild form, and confined to one side. Oral sepsis is sometimes responsible, but in the majority of cases no cause can be ascertained and the condition is attributed to exposure to cold or injury.

3. **Suppurative.**—The causes of this type are (a) spread from the mouth along Stenson's duct, (b) pyæmia, (c) exanthemata—*e.g.*, typhoid or scarlet fever. The condition is liable to supervene in debilitated and anæmic patients who are being rectally fed for a prolonged period; it is seen in cases of hæmatemesis and after abdominal operations, the dryness of the mouth being a contributory cause. Widespread dilatation of the salivary ducts, which may be congenital or acquired (sialogectasis), may be present. The gland suddenly becomes swollen and tender, the skin over it red and œdematous, and the temperature is usually high. Fluctuation follows in neglected cases, the pus tending to burrow among the deep muscles of the neck or to burst into the external auditory meatus. The outlook is very grave in all cases, many dying in spite of early treatment.

Treatment.—Many cases can be prevented by careful nursing and attention to the hygiene of the mouth and by the prompt use of sulphanilamide. Should the condition develop, free incisions should be made into the gland and drainage established as soon as possible. Hilton's method is of value in draining the deep-seated portions of the gland.

Ranula.—A cystic swelling in the floor of the mouth containing glairy mucoid fluid, which differs in composition from saliva. It may be a retention or degeneration cyst of the gland of Blandin and Nuhn, or of the nature of a dermoid arising from a displaced part of the cervical sinus. It forms a unilateral, smooth, rounded, bluish, translucent swelling to one side of the frænum and may displace the tongue. Treatment consists in the complete removal, if possible, of the cyst, but if not feasible any remnants of the cyst wall must be destroyed by diathermy.

Salivary Calculus.—Usually affects the submaxillary, seldom the sublingual, and rarely the parotid

gland. It consists of calcium phosphate and carbonate, and is opaque to X-rays in practically all cases. Attacks of painful swelling of the affected gland occur during and after meals, the swelling gradually subsiding before the next meal. In course of time the gland becomes permanently enlarged and indurated, with adhesion to surrounding structures. In cases of complete obstruction to the duct a cyst may develop and burst externally, leaving a salivary fistula. Abscess formation in the gland is also liable to occur. On examination of the mouth, the region of the duct is œdematous or indurated to an extent simulating malignancy and its opening obscured; on pressure over the gland, saliva and pus may exude from the orifice. In many cases the calculus can be felt in the floor of the mouth, but when buried deeply in the gland it usually cannot be palpated; it is disclosed on X-ray examination or after sialography—*i.e.*, introducing an opaque fluid into the ducts of the gland through a cannula before skiagraphy.

Treatment.—If accessible from the mouth, the calculus should be removed by free incision of the duct. If not, or in recurrent cases, excision of the submaxillary gland, together with the calculus, is indicated.

Salivary Fistula—1. *Parotid Fistula.*—This may affect either the gland or the duct. (a) Fistula of the gland may result from operations for removal of part of the gland in which sepsis supervenes, or from suppuration in the gland with or without a calculus. Discharge of clear watery saliva takes place at meal-times, but spontaneous healing is the rule after many months. In stubborn cases, section of the auriculo-temporal nerve or application of radium to the fistulous track may result in cure.

(b) Fistula of the duct is usually due to wounds, accidental or during operations. A continuous flow of saliva results, worse after meals. The portion of duct in front of the fistulous opening becomes obliterated and the fistula never heals of its own accord. The nearer to the gland the opening, the more difficult

it will be to close. In recent cases an attempt may be made to suture the duct, leaving a silk thread inside it with its end protruding into the mouth. In old-standing cases involving the buccinator region, the duct should be freely opened up from within, or if this cannot be done, an artificial opening should be made into the mouth, and maintained by drainage tubing. In masseteric fistula, a fine drainage tube should be passed from the mouth along the distal part of the duct and brought out at the fistulous opening. After a few days it is withdrawn slightly so that it does not project on the face; it is left in the duct for as long as possible, providing free drainage into the mouth. If this operation fails, avulsion of the auriculo-temporal nerve through a small incision in front of the external auditory meatus will usually result in cure.

2. *Submaxillary Fistula*.—This is rare, and if healing does not take place within a reasonable period, excision of the gland should be performed.

Mixed Parotid Tumour.—A comparatively common condition which is of great interest pathologically. The modern view favours its epithelial origin and that it is essentially an adenoma. Areas of epithelium, showing all gradations from adenomatous alveoli to solid masses of flattened epithelium of basal-cell type, are intermixed with mucoid, connective or cartilaginous tissue. Cases occur at all ages, the majority between twenty and forty years. A painless nodular swelling is noticed in the parotid region, which gradually increases in size over a number of years, and may then suddenly assume more rapid growth. Parotid tumours may be multiple and sometimes occur in the substance of the cheek or palate. No inconvenience is caused unless the tumour becomes of large size, when mastication may be difficult. On examination the skin is found to be stretched over the tumour, but not adherent; in most cases the swelling is movable and areas of softening can sometimes be detected. The presence of facial paresis usually means that malignant changes have supervened.

Treatment.—Excision of the tumour can usually be effected in spite of its friable nature, but great care is necessary to preserve the facial nerve, which often lies on the deep surface, but is sometimes enveloped by the growth. Some authorities advise against operation because of the risks of dissemination and prefer to intervene only if the tumour rapidly increases in size. Operation should be followed by prophylactic irradiation.

Malignant Parotid Tumour.—Carcinoma of the parotid is by no means uncommon; the majority follow the incomplete removal of mixed tumours of the gland. The growth is an adeno-carcinoma of alveolar or papillary type, or a cylindroma consisting of anastomosing cords of epithelial cells enclosing spaces filled with mucus. Spindle or round cells are found in some cases, which have erroneously been designated sarcoma. Clinically these tumours are of rapid growth and hard, with early infiltration of surrounding structures and facial paralysis. They tend to spread to the neighbouring cervical lymph glands. Pain is often present and the skin soon infiltrated, discoloration being followed by ulceration.

Treatment.—Removal of the whole parotid is usually out of the question owing to involvement of surrounding structures, but it is occasionally both practicable and successful. Radium needles or radon seeds may be implanted into and around the tumour or treatment by telerradiation employed, and in many cases temporary regression of the growth follows. Recurrence either locally or in the lymph glands is the rule at a later date.

Submaxillary Gland Tumours.—Mixed tumours and carcinoma both occur, less commonly than in the parotid; the clinical features and treatment are on the same lines as in the case of the latter gland.

Mickulicz' Disease.—A slow chronic enlargement of the salivary and lachrymal glands, generally occurring in adult males, and of unknown ætiology. Xerostermia and conjunctivitis may occur. Histologically there is generalized lymphocytic infiltration. X-ray therapy may effect resolution.

THE PALATE

Cleft Palate.—A congenital defect in the roof of the mouth due to failure of union of the palatal segments. The condition may be limited to the uvula, which is bifid, may involve the soft palate alone, or both hard and soft palates may be affected. If complete, the alveolus is involved and single or double hare-lip is usually present. The width of the cleft varies considerably, and the lower edge of the nasal septum may project between the palatal processes, making the cleft appear double, or more commonly is joined to one of them. The roof of the mouth is sometimes highly arched, a fact of importance when repair is undertaken, as the flaps meet more easily in this type (see Fig. 32).

Effects.—Nutrition is interfered with in the severe type, regurgitation taking place through the nose; by careful spoon-feeding no case need be lost, but owing to ignorance many cases die from malnutrition. In those that survive speech is indistinct, the voice having a nasal character, and difficulty is experienced in pronouncing those consonants which require a raised pressure within the mouth (explosives, such as *b, d, p, t, f, g*). Taste and smell are diminished, chronic rhinitis and pharyngitis being liable to follow.

Treatment.—In the first few months care must be taken to spoon-feed the child with the head well back. Operation is needed to repair the cleft, and the best time for this varies with the type of defect. The narrow cleft of the soft palate may often be closed successfully at nine to twelve months; the wider and more complete cleft is often better postponed until eighteen months, when, however, the habit of faulty speech is difficult to overcome. Infections of the mouth and nose must be carefully treated, and the general health improved before operation is undertaken, the best times being the spring and summer. Two alternative methods are available:

1. The Veau-Langenbeck operation. Flaps of

muco-periosteum are raised on each side of the cleft and the soft palate is completely detached from the posterior border of the hard palate. Tension on the flaps is reduced when necessary by the use of lateral incisions. The edges of the cleft are then pared and

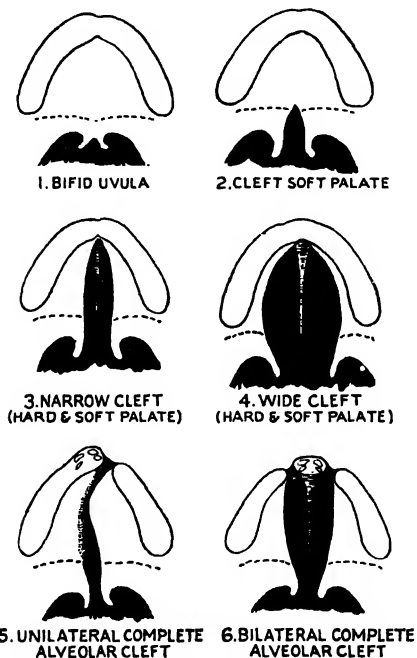


FIG. 32.—VARIETIES OF CLEFT PALATE.

sutured together. Veau's modifications permit of the more careful suture of the nasal aspect of the defect and also allow of relief of tension by several different procedures adapted to the varying types of cleft, so that the defect of the Langenbeck operation

—viz., a tendency to antero-posterior contraction of the soft palate—is to some extent eliminated. The complete division of the hamular processes helps to relieve transverse tension, and combined with Wardill's operation—viz., raising a ridge on the posterior wall of the naso-pharynx to minimize the space which the soft palate has to occlude—is most valuable.

2. Gillies'. In this no attempt is made to close the gap in the hard palate by operation. The soft palate is completely detached from the back of the hard palate on each side, the edges of the cleft are pared and sutured together without removing any tissue. An obturator is provided at a later date.

Co-operation between surgeon and dentist is essential in all difficult cases, and the speech trainer can often restore good functional speech in surgical failures.

Ulcers.—These may be of the following types:

1. *Simple*.—May be found in the various kinds of stomatitis.

2. *Syphilitic*.—(a) Secondary stage: Mucous patches and snail-track ulcers occur on both the hard and soft palate. (b) Tertiary stage: Gumma of the hard palate occurs as a median rounded swelling which later softens and bursts, leading to ulceration. Perforation of the palate may result from necrosis. In the soft palate scarring, contraction and adhesion to the back of the pharynx result, producing a nasal tone to the voice.

3. *Lupoid*.—Usually seen in children, and due to spread of lupus from the nose, lips, or cheeks. It may cause severe destruction of tissue.

4. *Malignant*.—Epithelioma may arise in the hard or soft palate or may extend to them from the tongue, jaw, or tonsil.

Tumours—1. *Adenoma*.—This usually occurs between fifteen and thirty years of age, appearing as a slowly growing submucous tumour of the soft palate to one side of the middle line.

2. *Papilloma*, *epithelioma*, *fibroma*, *parotid 'adenoma'* and *sarcoma* all occur. Infiltration of the palate is often found in growths commencing in the maxillary antrum.

Elongation of the Uvula.—This is sometimes found in chronic pharyngitis, giving rise to an irritating, persistent cough, which is worse when lying down, and sometimes vomiting. Astringents applied locally often relieve the condition; if not, the uvula should be painted with cocaine and about two-thirds snipped off with scissors.

CHAPTER XXVI

AFFECTIONS OF THE NOSE AND NASO-PHARYNX

THE NOSE

Fractures.—The Nasal Bones are often fractured transversely by direct violence. Occasionally the base of the skull is fractured in addition. The signs are swelling and pain, crepitus, lateral displacement with epistaxis, and sometimes surgical emphysema. As the fracture unites quickly, it is important to recognize its presence and reduce the deformity at once. The septum may be broken alone or with the nasal bones.

Treatment.—Immediate reduction by the introduction of guarded forceps into the nasal cavity, combined with external pressure. A splint is then moulded over the nose.

Foreign Bodies.—Peas, beads, etc., are commonly impacted in the nose in children, giving rise to a unilateral purulent discharge and nasal obstruction on the affected side. If seen to be smooth and rounded, the simplest method of removal is to pass a blunt-pointed director along the floor of the nose and then to elevate the point and gently withdraw it together with the foreign body. When the object is firmly impacted or jagged in outline, the nose should be cocainized, a general anæsthetic given and removal effected by forceps, using a nasal speculum under good illumination.

Epistaxis.—Nose-bleeding may be due to a number of causes: (1) Trauma. This may be confined to the

mucous membrane or be associated with injuries to the nasal bones or fractured base of the skull. (2) Ulcer of the septum. This is produced by children picking their noses after an attack of rhinitis. (3) Foreign bodies. (4) Intracranial diseases associated with venous congestion, especially of the frontal region—*e.g.*, frontal meningiomas. (5) High blood pressure, epistaxis being often precipitated by sneezing or coughing. (6) Puberty and adolescence. Females are more commonly affected, in association with abnormalities of the ductless glands. (7) Changes in atmospheric pressure. (8) Blood diseases such as hæmophilia, purpura and scurvy. (9) Chronic nephritis. (10) Cardiac or pulmonary disease. (11) Specific fevers—*e.g.*, typhoid fever. (12) Nasal diphtheria. (13) Tumours of the nose, accessory sinuses or naso-pharynx—*e.g.*, angioma or sarcoma. (14) Nasal polypi. The characteristic watery discharge may rarely be blood-stained.

Treatment.—In the great majority of cases the bleeding is from one side of the nose only, and from the front part of the septum—*i.e.*, in the vestibule. All that is necessary to control the hæmorrhage until clotting occurs is to exert pressure against the vestibule with the finger on the affected side of the nose. The head should be raised and ice applied to the root of the nose. If bleeding recurs after releasing the pressure, the nose should be examined with a nasal speculum in a good light, when the bleeding point will be seen. It can then be controlled by touching the affected site with a diathermy needle or by pressure with a swab soaked in adrenalin or chromic acid (5 per cent.). Plugging is rarely needed, but when required a rubber bag should be employed and packed with gauze through a Casselberry nasal packer. Ribbon gauze, soaked in adrenalin and soft paraffin, may be used for the anterior nares. If this fails, a soft rubber catheter should be passed along the floor of the nose, the end pulled into the mouth, and a silk thread tied to it; to the other end of this a sterile gauze pad $1\frac{1}{2} \times 1$ inch is attached. The catheter and thread are then

withdrawn until the gauze pad is exerting firm pressure in the posterior nares, a finger being used to guide it into place.

Deviation of the Nasal Septum.—Is only of importance when of such a degree that unilateral nasal obstruction together with chronic rhinitis result. Two conditions frequently coexist: (1) Deviation, mainly of the cartilage; it is sometimes of traumatic origin. (2) Spur formation, which is often congenital in origin and consists in a cartilaginous or bony thickening of the septum. Some cases are due to injury in childhood, and in these nasal asymmetry is obvious; in others the palate is usually high and arched, and the nasal condition is presumed to be secondary to this. Asthmatic attacks may possibly be due in some cases to severe deviations of the septum. The treatment consists of submucous resection under a local or general anæsthetic.

Acute Rhinitis.—Is frequently met with in the guise of the common cold; it may also be one of the first indications of influenza, measles, whooping-cough and other infectious diseases, or result from irritating gases, dust or pollen (hay fever). It also follows administration of certain drugs, such as potassium iodide. The condition often involves the accessory nasal sinuses and Eustachian tubes, resulting in frontal headache, deafness and anosmia. In addition to the usual well-known remedies, inhalations of Friar's balsam or menthol, or spraying the nose with a 1 per cent. solution of ephedrine sulphate in normal saline may be found useful.

Chronic Rhinitis.—Several types may be distinguished:

1. **Simple.**—In the majority of cases some underlying cause such as disease of the accessory sinuses or adenoids is responsible; in a few occupation is the cause—*e.g.*, working in a dusty atmosphere. Deviation of the nasal septum is often present, and this, in conjunction with œdema and thickening of the mucous membrane, may give rise to nasal obstruction.

2. **Hypertrophic.**—A common form in which the

mucous membrane, especially of the posterior end of the inferior turbinate, is œdematous and swollen; in marked cases it appears papillomatous and polypoid. The result is often nasal obstruction with profuse discharge of muco-pus. Disease of the accessory sinuses, pharyngitis or laryngitis may also be present. Males with prominent narrow noses are especially liable to be affected.

3. **Rhinitis Sicca.**—In this the tissues are less vascular than usual and secretion scanty. The condition is often the result of working in a hot dry atmosphere.

4. **Atrophic.**—The outstanding feature in this type is fibrosis of the submucous tissue, resulting in decreased blood supply, shrinkage of erectile tissue and loss of ciliated epithelium, which is replaced by squamous cells. Secretion is diminished and crusts form which may decompose and give rise to an offensive smell (ozæna). The nasal fossæ appear roomy, the mucous membrane glazed, while the pharynx and possibly the larynx as well are dry and crusted. The ætiology is unknown, but it commonly starts at or after puberty and the worst symptoms lessen after the menopause. It is more common in females and seems sometimes to follow a severe purulent rhinitis such as can occur in the course of one of the infectious fevers of childhood. The patient is not aware of the foul odour, which results from decomposition of the retained nasal secretion, but nasal obstruction and mouth-breathing are present.

Treatment.—Daily irrigation with salt solution followed by a spray of menthol and paroleine (10 grains to the ounce), and plugging the nose with wool tampons soaked in protargol or argyrol (10 per cent.) should be combined with attention to the general health.

5. **Diphtheritic.**—Is usually found in children and liable to be overlooked unless swabs are taken.

6. **Syphilitic.**—Diffuse gummatous infiltration of the septum may result in suppuration, caries or necrosis, followed by depression of the bridge of the nose. Perforation of the septum or of the hard palate also occurs.

7. **Tuberculous.**—Lupus may commence in the

vestibule at the junction of skin and mucous membrane, apple-jelly nodules being followed by ulceration and caries of the septum, sometimes with perforation. Spread of ulceration in some parts, accompanied by healing and contraction in others, results in deformity.

Nasal Polypus.---By this is meant an œdematous pedunculated mass of glistening grey appearance arising from the mucosa of the nose or of the nasal sinuses. Microscopically the polypus is usually covered by non-ciliated cuboidal epithelium, and its delicate stroma contains many eosinophile cells.

Polypi occur in chronic cases of nasal allergy. They are usually multiple and arise from the region of the middle turbinate bone or from the nasal sinuses—especially the ethmoidal cells. The septum and inferior turbinate bone are not affected. They interfere with drainage and predipose to chronic nasal sinus infection.

Symptoms.—Gradually increasing nasal obstruction, which may be unilateral or bilateral and occurs especially in damp weather, is found in association with a watery discharge, which is rarely blood-stained. The voice may become nasal and headaches result from obstruction to the opening of the frontal sinus. On examination, polypi appear as pedunculated, pale grey, smooth, glistening, semitranslucent masses, around the neck of which a probe can be passed.

Treatment.—Removal by a wire snare is the usual method. Anæsthesia is produced by equal parts of adrenalin and cocaine (10 per cent.) applied on wool. The loop of the snare is then passed over the polypus and up to its neck, when it is gradually tightened. The polypus is then removed by dragging on and twisting the snare. If bleeding is free, the nasal cavity is packed for twenty-four hours but not too tightly, owing to the danger of meningitis from ascending infection. Polypi tend to recur as long as the cause of the nasal allergy persists.

Frontal Sinusitis.—This is due in practically all cases to extension of infection from the nose and maxillary antrum, frequently the result of influenza

or the common cold. Frontal headache, pyrexia and tenderness on pressure over the frontal sinus are usually present. The fronto-nasal duct may become blocked by œdematous swelling of the mucous membrane and an empyema of the sinus results; extension through the wall may lead to osteomyelitis of the frontal bone, extradural abscess, meningitis or cerebral abscess.

Treatment.—Free drainage must be provided, and this is brought about by removal of polypi, anterior ethmoidal cells or middle turbinate bones if enlarged, correction of deviation of the nasal septum, and by treatment of any disease of the maxillary antrum if this is present. When these measures fail, external operation is indicated. A curved incision is made below the eyebrow, and either the floor of the sinus only (Howarth's operation) or both the floor and anterior wall are removed; a large opening, which is skin-grafted at the time of operation, is made into the nose.

Ethmoiditis and Sphenoiditis.—The ethmoidal air cells and also the sphenoidal air cells and sinus are liable to be involved in acute rhinitis, and in some cases chronic disease of these parts may follow. In the case of the ethmoid, caries and polypus formation are of frequent occurrence.

Adenoids.—These are due to an overgrowth of the lymphoid tissue of the naso-pharynx forming soft, vascular masses which project from the roof and posterior wall of the pharynx. The condition is common in children living in crowded, unhygienic surroundings and of the catarrhal diathesis, being usually found in association with enlarged tonsils. If of sufficient size to cause obstruction to nasal breathing, the child becomes a mouth-breather with a characteristic facies. The nose is narrow, the nostrils drawn in and the mouth held partly open, while the expression is vacant and dull. The palate becomes high and arched and the incisor teeth prominent. In time, flattening of the chest, kyphosis and pot-belly result. Chronic rhinitis, deafness from obstruction of the Eustachian tubes, and otitis media are also of frequent occurrence.

Treatment.—Removal by operation. Gottstein's adenoid curette, La Force's adenotome and Luc's forceps are all employed. No tags should be left behind, otherwise bleeding may continue with serious results. Otitis media is liable to follow removal of adenoids, giving rise to earache, rise of temperature and discharge from the ear.

Tumours of the Nose and Naso-pharynx.

1. **Innocent.**—Papilloma, fibroma, angioma, osteoma and chondroma are all rare.

2. **Malignant.**—Sarcoma and carcinoma both occur.

Naso-pharyngeal Fibroma.—An uncommon tumour arising from the basi-sphenoid or basi-occipital bone. It forms a firm, smooth or lobulated growth which may extend forwards into the nose and accessory sinuses, outwards into the temporal and malar regions, or upwards into the orbit and cranium, causing bony atrophy. It is composed of dense fibrous and elastic tissue, round or spindle cells with numerous vessels sometimes cavernous in type (angio-fibroma). One of its striking features is that after partial removal complete spontaneous regression sometimes takes place towards the twenty-fifth year—*i.e.*, when skeletal growth ceases.

Signs and Symptoms.—This tumour is found chiefly in males, and almost always between ten and twenty-five years of age. Nasal obstruction, epistaxis and deformity (frog-face) are followed by a foul discharge from the nose. Death may ensue from anæmia, septic absorption or meningitis.

Treatment.—Removal of the tumour should be attempted by Nélaton's operation, in which the soft palate is divided in the middle line, the posterior part of the hard palate and nasal septum removed if necessary to allow of free access to the naso-pharynx. Preliminary bilateral ligation of the external carotids is often necessary to control hæmorrhage, which otherwise may be alarming. When removal is not possible, radium should be inserted and may lead to marked shrinkage of the tumour.

CHAPTER XXVII

AFFECTIONS OF THE TONSIL AND PHARYNX

THE TONSIL

Acute Tonsillitis.—The tonsil is very commonly inflamed, especially during the winter months and in the spring, also frequently in epidemics of so-called influenza. The infection is usually a mixed one, staphylococci, pneumococci, and streptococci often being responsible. Tonsillitis is sometimes divided into parenchymatous and follicular varieties, but the distinction is of no practical value. In most cases the temperature is raised, with malaise, headache and general pains, and the patient complains of a sore throat. The tonsils appear swollen and reddened, often with yellow areas indicating the sites of distended follicles. The discharge may coagulate on the surface, forming a false membrane, which is more easily detached than the diphtheritic membrane and does not bleed in the process. The tongue is thickly furred and the glands at the angle of the jaw are tender and enlarged.

Treatment.—Rest in bed, ample fluids and light diet with regular evacuation of the bowels are the main indications. Locally, frequent warm antiseptic gargles—*e.g.*, peroxide of hydrogen or carbolic acid 1:80—and painting the tonsils with Mandl's paint are of value. Aspirin and similar drugs assist in relieving pain and malaise, reducing the temperature and promoting free perspiration.

Peritonsillar Abscess, or Quinsy.—This occurs as a complication in some cases of acute tonsillitis, an abscess forming usually at the upper pole outside the capsule of the tonsil, but occasionally in the tonsil itself. The condition is often unilateral, but not infrequently the second side is affected several days after the first. The temperature is high, pain severe, and both swallowing and breathing may be difficult owing to the marked swelling which is usually present.

Trismus often renders examination difficult, but marked bulging and œdema of the anterior pillar of the fauces and soft palate, with congestion of the mucous membrane, can usually be made out, and fluctuation can sometimes be detected. If not opened, the abscess points and bursts.

Treatment.—The throat, palate and tonsillar region should be sprayed or swabbed with cocaine (10 per cent.) and adrenalin in equal parts. The abscess is then incised just internal to the mid-point between the base of the uvula and last upper molar tooth. The mucous membrane is divided with a scalpel, the blade of which has been covered, except at the distal $\frac{1}{4}$ inch, with adhesive strapping. A pair of sinus forceps is then inserted more deeply, and as soon as pus appears the forceps is withdrawn with the blades open. Hot gargles, with fomentations to the neck, should afterwards be employed, and after the acute stage has subsided tonics are often needed for the marked debility from which these patients suffer. Quinsy is very liable to recur unless the tonsils are enucleated after the patient has fully recovered from the acute attack.

Chronic Tonsillitis.—Is commonly found in children of the poorer classes living in bad hygienic surroundings. It may follow an acute attack, though not invariably. The exanthemata, scarlet fever and measles particularly, are often responsible by lowering both the general health and the local resistance of the tonsil as well.

The tonsils often become enlarged, pale and firm, the crypts being filled with inspissated material which can be squeezed out by pressure on the anterior pillar. In other cases the tonsils may become shrunken and buried as the result of fibrosis. In children adenoids are often present, the patient breathes with the mouth open, and deafness and middle ear complications are of frequent occurrence. In nearly all cases the cervical glands on both sides are enlarged, particularly those below the angle of the jaw. Tuberculous disease of both the tonsils and cervical glands is very liable to be superadded in children. Acute nephritis and acute

rheumatism, with resultant cardiac disease, may be due to chronic tonsillitis.

Treatment.—In early cases attention should be paid to the general health, the child being sent away if possible to a healthy atmosphere, or alternatively, treated by ultra-violet light, a diet providing ample vitamins, and tonics containing iron. Local treatment consists of painting the throat with astringents such as glycerine and tannic acid. If these measures fail to effect a cure, enucleation of the tonsils should be carried out, combined if necessary with removal of the adenoids.

Syphilis.—(a) Primary chancre is rare, and associated with marked glandular enlargement, secondary signs soon following. (b) Snail-track ulcers and mucous patches both occur. (c) Gummatous ulceration may extend deeply and be followed by severe deformity and adhesion of the soft palate, causing interference with swallowing and nasal regurgitation of food.

Tumours.—Epithelioma, lympho-sarcoma, and round-celled sarcoma are the most important. Rapid local infiltration and early spread to lymph glands is characteristic of them all. Treatment by high-voltage X-rays or radium bomb offers the only hope of arresting the disease.

THE PHARYNX

Pharyngeal Diverticulum.—Pressure diverticula occur through the relatively weak area in the inferior constrictor of the pharynx between the laryngo-pharyngeus and the crico-pharyngeus muscles. The pouch extends downwards and slightly to the left, sometimes as far down as the superior mediastinum. Adults are generally but not exclusively affected. Food collects in the pouch and decomposes, a swelling may be noticed by the patient, and regurgitation of food is often troublesome. Dysphagia may eventually produce emaciation. In addition to these median diverticula, lateral pouches have been described.

Diagnosis is made by skiagraphy, which enables the size of the pouch to be estimated. Œsophagoscopy is useful for confirmation.

Treatment.—An œsophagoscope is first passed. An incision is made on the left side of the neck at the level of the cricoid, the sterno-mastoid and carotid sheath retracted outwards and the trachea and thyroid inwards to expose the œsophagus (with indwelling œsophagoscope) and pharyngeal pouch, the latter is defined fully and then exteriorized. Ten days later the pouch is excised and the gap in the pharyngeal wall sutured. A one-stage operation is performed by some, while others are content to displace and fix the pouch so that its orifice lies below its fundus, and therefore it remains empty.

Acute Pharyngitis.—Is found in association with rhinitis and tonsillitis, and due to the same causes. The pharyngeal mucous membrane is injected and œdematous, with muco-pus on the surface. Pain on swallowing and an irritating cough are the main symptoms. Local treatment consists of warm inhalations of Friar's balsam or spraying the pharynx with demulcents.

Chronic Pharyngitis.—Public speaking, alcoholism and excessive smoking are the main causes. It may follow an acute attack, or be insidious in onset. The pharynx is injected and glazed with a good deal of muco-purulent discharge. In the follicular or granular variety lymphoid enlargement is a prominent feature, especially in the soft palate; the uvula may be hypertrophied. The atrophic type is usually found in association with atrophic rhinitis, and may spread to the larynx; the mucous membrane becomes shiny and covered with dried-up secretion. Dryness of the throat and huskiness are the main complaints.

Treatment.—Overuse of the voice, alcohol and smoking must be prohibited. Locally astringent sprays or applications are of use; menthol and paroline spray, menthol and benzoin inhalations or lozenges of menthol and liquorice are frequently employed. Cauterization of the follicles may be necessary in the granular type.

Vincent's Angina.—A specific type of pharyngitis due to *Bacillus fusiformis* (Vincent) and a spirochæte;

it may spread to the tonsils and mouth. Ulceration occurs, the ulcers being covered by fibrinous exudate forming a yellowish membrane, removal of which causes bleeding. Injection of an organic arsenic compound, such as novarsenobillon intravenously, combined with local applications of liquor arsenicalis, results in cure.

Syphilis.—(a) Mucous tubercles and snail-track ulcers are found in the secondary stage. (b) Diffuse gummatous infiltration may be followed by stenosis of the pharynx, for which dilatation by bougies and division of constricting bands may be required. (c) Localized gumma formation also occurs.

Carcinoma.—This is not uncommon, especially in middle-aged men, and arises usually in or near the pyriform fossa. In many cases few symptoms result until spread has taken place to the cervical glands. A painless swelling is noticed in the upper deep cervical region, rapidly increasing in size. At a later stage, neuralgic pain, slight dysphagia, blood-stained expectoration and huskiness of voice follow. In a few early cases removal of the primary growth may be attempted by Trotter's method of lateral pharyngotomy, together with excision of the cervical glands. In the vast majority insertion of radon seeds into the primary growth combined with telerradiation or high voltage X-rays to both primary growth and regional glands is the only method practicable.

Retro-pharyngeal Abscess.—This may be either acute or chronic.

1. *Acute.*—In some cases due to trauma, such as a fish bone penetrating the mucous membrane, but usually the result of infection of the retropharyngeal lymph glands in children. Pus forms between the wall of the pharynx and the prevertebral fascia.

2. *Chronic.*—Usually the result of tuberculous disease of the cervical spine, and in this case the pus tracks behind the prevertebral fascia (see Fig. 30).

In both the acute and chronic varieties an elastic swelling may form, bulging the posterior wall of the pharynx forwards, or the abscess may track outwards and present in front of or behind the sterno-mastoid

muscle. In acute cases œdema may extend to the glottis, causing urgent dyspnœa.

Treatment.—Acute cases may be opened from the mouth in the head-down posture. In chronic cases repeated aspiration is to be tried, and if the abscess should need opening this must be carried out from the side of the neck, precautions being taken to avoid secondary infection, and the wound closed with the greatest care.

CHAPTER XXVIII

AFFECTIONS OF THE ŒSOPHAGUS

Dysphagia.—By this is meant pain or difficulty in swallowing. In the investigation of a case of dysphagia systematic examination of the mouth, pharynx, larynx, œsophagus, neck and chest is essential to arrive at the diagnosis. The mode of onset of symptoms should always be noted carefully.

Causes :

I. EXTRINSIC.

(a) *Cervical.*—

1. Adenitis of cervical glands and retro-pharyngeal abscess.
2. Enlargements of the thyroid gland.
3. Malignant disease not arising in the pharynx or œsophagus.
4. Aneurysm of the carotid arteries.

(b) *Intrathoracic.*—

1. Enlarged mediastinal glands.
2. Retrosternal goitre.
3. Growths of the mediastinum, lung and spinal column.
4. Backward dislocation of the sternal end of the clavicle.
5. Aneurysm of the aorta and main branches.

(c) *Plummer-Vinson syndrome (see p. 340).*

II. INTRINSIC.

(a) *Pharyngeal*.—

1. Foreign bodies.
2. Diverticulum.
3. Acute or chronic pharyngitis.
4. Syphilitic pharyngitis.
5. Stenosis of the pharynx following ulceration.
6. Malignant disease of the pharynx.
7. Bulbar paralysis.
8. Hysteria.

(b) *Laryngeal*.—

1. Acute or chronic laryngitis.
2. Tuberculous laryngitis.
3. Syphilitic laryngitis.
4. Malignant disease of the larynx.

(c) *Œsophageal*.—

1. Foreign bodies.
2. Acute or chronic inflammation.
3. Achalasia or cardiospasm.
4. Fibrous stricture.
5. Peptic ulcer.
6. Malignant disease.

Malformations—1. *Congenital*.—A small fistula may be present between the œsophagus and the trachea, or the upper end of the œsophagus may be blind. Congenital stricture and congenital shortening also occur, the latter being associated with displacement of the stomach through the diaphragm. A congenital membrane, sometimes tenuous and occasionally perforated, may, when complete, cause obturation at the upper end of the œsophagus. If recognized at once it is easily perforated.

2. *Acquired*—*Traction Diverticulum*.—This is rare, and usually occurs near the bifurcation of the trachea. It results from contraction of scar tissue following inflamed bronchial glands or malignant disease in the mediastinum, causes no symptoms, and no treatment is called for.

Foreign Bodies.—Coins, tooth plates, fish bones

and unmasticated portions of food may lodge in the œsophagus. Impaction of a large body at the junction of pharynx and œsophagus may lead to immediate death from asphyxia. In other cases impaction is liable to be followed by ulceration and perforation of the œsophagus, causing either severe hæmorrhage, mediastinitis or cervical cellulitis.

Treatment.—X-ray examination should be carried out to verify the diagnosis, locate the site of impaction and ascertain the shape and size of the foreign body. Removal should then be attempted by œsophagoscopy, a general anæsthetic being advisable in most cases. By this means the foreign body can in a majority of cases be disimpacted, broken up if necessary and removed. If this method fails, lateral œsophagotomy must be performed, through an oblique incision low down on the left side of the neck. The œsophagus is opened, the foreign body removed, and the walls sewn up with the exception of the mucous membrane, free drainage of the neck being provided. In a few cases of impaction near the lower end of the œsophagus, laparotomy followed by opening of the stomach will enable digital dilatation of the cardia and removal of the foreign body to be carried out.

Inflammation of the Œsophagus.—This is due in most cases to swallowing corrosives or irritants, sometimes to the impaction of a foreign body. Pain and dysphagia are the main symptoms, and the treatment consists in keeping the patient on bland fluids, or in severe cases prohibiting all food by mouth with the substitution of rectal feeding.

Spasm of the Œsophagus (*Hysterical Spasm or Globus Hystericus*).—This gives rise to dysphagia in neurotic young women, who complain of a sensation of a ball rising in the throat. When the patient's attention is diverted swallowing can be carried out normally. Psychological treatment is indicated, and in some cases the passage of an œsophageal bougie is of value.

Achalasia (*Cardiospasm or Œsophagospasm*).—In this condition there is obstruction to the passage of food from the lower œsophagus to the stomach.

The cause is unknown, the cardiac sphincter being apparently normal, while the œsophagus is dilated, often lengthened, and its muscular walls thickened and hypertrophied. Middle-aged women are most often affected, but it may occur in both sexes and at all ages. The onset of symptoms may be sudden or gradual. Attacks of dysphagia, regurgitation of food and a heavy sensation in the lower part of the chest are the main symptoms; in some cases the condition progresses steadily and results in marked emaciation, while in others free intervals occur and the patient may appear to be well. The diagnosis can usually be arrived at by X-ray examination after an emulsion of barium or bismuth has been swallowed. The opaque material is held up at the lower end of the œsophagus, which may be very much dilated and tortuous above the constriction. The outline of the latter is smooth and conical.

Treatment.—(1) Hurst's mercury-loaded bougie, which the patient is taught to pass at regular intervals. (2) Manual dilatation of the constriction from below, after the stomach has been opened through a laparotomy wound. This method, if carried out with care so as to avoid rupture of the œsophagus, gives the best and most permanent results. (3) Operations on the sympathetic nerves accompanying the left gastric artery have not proved satisfactory, and œsophago-gastrostomy is hazardous.

Fibrous Stricture.—This results from cicatricial contraction of the wall of the œsophagus, due in most cases to the swallowing of corrosives or impaction of foreign bodies, occasionally to a gumma or a healing gastric ulcer in the region of the cardiac orifice. The usual sites of constriction are (a) at the upper end, (b) just below the bifurcation of the trachea, and (c) the cardiac orifice. In many cases several strictures are present. Gradually increasing dysphagia, at first for solids and later fluids, is complained of, and the patient can usually indicate the level at which food seems to be held up. If the obstruction is at the upper end of the œsophagus, the food regurgitates immediately or soon after

swallowing; if lower down, the œsophagus dilates and several hours may elapse before regurgitation. In time, emaciation and death from starvation result.

Treatment.—(1) Œsophagoscopy and dilatation with bougies under direct vision. A few days are allowed to elapse between the dilatations, and too much should not be attempted at each sitting owing to the danger of rupturing the œsophagus. (2) If the stricture recurs, a soft rubber tube is passed under direct vision and left in position for several weeks, the upper end being brought out of the mouth and fixed to the ear. Swallowing takes place by the side of the tube, the presence of which gradually dilates the stricture. (3) Plummer's method. One end of a length of silk is swallowed and a Plummer's bougie, which has a hollow channel running through the tip of it, is guided along the silk and through the stricture. By this means dilatation may be possible by the use of larger bougies at regular intervals. (4) Retrograde dilatation. This is sometimes possible in strictures near the lower end, bougies being passed after the stomach has been opened. (5) Gastrostomy is sometimes needed when starvation is threatened, and the rest given to the œsophagus may facilitate dilatation later. (6) Plastic reconstruction of the œsophagus, utilizing skin flaps combined with segments derived from the stomach or intestine which have been brought underneath the superficial tissues of the chest wall, has occasionally given brilliant successes.

Carcinoma.—This is usually a squamous-celled growth, occurring mainly in men over the age of forty. Though said to be commonest at three sites—viz., (a) at the junction of pharynx and œsophagus; (b) where the œsophagus is crossed by the left bronchus; and (c) at or near the cardiac orifice—it may occur anywhere. In some cases it spreads from the cardiac end of the stomach, when the growth is columnar celled. The majority of cases in men are found in the thoracic portion, but in women the cervical œsophagus is more often affected. The growth tends to spread

around the œsophagus and to infiltrate locally, while distant metastases are rare. The trachea, pleural cavity, mediastinum or large thoracic vessels may become involved, causing perforation of the trachea, and septic pneumonia, lung abscess, suppurative mediastinitis or secondary hæmorrhage.

Symptoms.—Steadily increasing dysphagia, at first for solids and later for liquids, is associated with rapid emaciation. The patient will often indicate the place at which food ‘seems to stick,’ and in the later stages regurgitation of food and frothy blood-stained mucus takes place at varying intervals after swallowing. Hoarseness, present in a few cases, is due to involvement of the recurrent laryngeal nerve, or to direct spread to the back of the larynx. As a rule no pain is complained of, and there is an absence of local physical signs, but in growths at the upper end referred pain in the neck and a palpable tumour are sometimes present.

Diagnosis.—X-ray examination after a barium swallow will usually establish this beyond doubt. The barium emulsion is delayed in its passage and a thin irregular shadow is seen at the site of the growth. Œsophagoscopy may enable a small portion of suspected growth to be removed for microscopical examination.

Treatment—1. *Dilatation.*—This may be carried out by a variety of methods. (a) Graduated gum-elastic bougies may be passed under direct vision through an œsophagoscope. (b) Bougies may be passed blindly. (c) Plummer’s perforated bougies may be passed along a silk thread, swallowed some time previously.

2. *Intubation.*—Symonds’ flanged tube or Souttar’s modification made of flexible German silver wire may be introduced into the stricture and left *in situ* for several months. Hill’s tube is of use in very tight strictures; it consists of a fine silver wire covered by rubber and having a smooth conical tip. This is passed through the stricture and the tube left in position with its upper end projecting from the mouth and tethered to the ear. It will be found that the patient can swallow

along the side of the tube, which also tends to dilate the stricture.

3. *Irradiation*.—This may be employed by surface application in the form of a platinum tube containing radium wedged in a hollow gum-elastic œsophageal catheter. The site and extent of the growth are accurately measured by œsophagoscopy and by skiagrams, and the catheter containing the radium left in position for a number of hours daily. An alternative method is the insertion of radon seeds either through an œsophagoscope or after exposure of the growth from without by thoracotomy. Deep X-ray therapy is here more efficacious than radium therapy. Steps must be taken to protect the lungs, etc., as far as possible. The tendency to late stenosis must be checked by regular dilatation.

4. *Excision of the Growth*.—This has been successful in a limited number of early cases mainly affecting the upper end, and in a few cases it is possible to excise growths of the thoracic œsophagus, closing the lower end and withdrawing the upper end into the neck to form a fistula which can later be utilized to convey normally masticated food through a rubber tube which communicates below with an artificial gastric stoma.

5. *Gastrostomy*.—This should always be performed as soon as the patient is unable to swallow the equivalent of 2,500 calories per diem; it is often of great value in conjunction with other forms of treatment.

6. *Tracheotomy* is occasionally needed when the larynx is involved.

Plummer-Vinson Syndrome.—Here there is obstruction to passage of food from pharynx to œsophagus. The condition is usually found in adults, especially women. There is spasm of the crico-pharyngeus controlling the œsophageal inlet, associated with dryness and glazing of the pharyngeal and buccal mucosa, fissuring at the angles of the mouth, fragility of finger-nails, and secondary anæmia. Treatment is by œsophagoscopic dilatation as well as measures directed to the anæmia.

CHAPTER XXIX

AFFECTIONS OF THE EAR

External Ear.

Congenital Abnormalities.—Congenital absence of the pinna or closure of the external meatus is rare and nothing can be done to rectify them. Accessory auricles consisting of fibro-cartilage covered with fat and skin are not uncommon and may need excision. The ears may be large and prominent, a deformity which can be corrected by excision of a V-shaped portion.

Hæmatoma Auris.—This is usually the result of trauma, being found in boxers, Rugby footballers and the insane. The auricle becomes swollen and discoloured, deformity resulting from contraction unless the swelling is punctured and the hæmatoma evacuated.

Foreign Bodies.—In most cases these can be removed by syringing, but if this fails removal should be attempted by fine forceps or a sharp hook. On rare occasions it is necessary to detach the auricle by a posterior incision to obtain access to the deeper parts of the meatus.

Eczema.—The auricle is frequently the seat of acute or chronic eczema, which may spread to the meatus. A sedative lotion—*e.g.*, lotio plumbi—or a dusting powder of starch and zinc oxide is useful in acute cases, while chronic ones usually respond to an ointment containing resorcin or ichthyol.

Furunculosis.—Boils, which are resistant to treatment and recur readily, often attack the meatus. Acute pain and marked tenderness on movement of the auricle are present and the condition may be difficult to distinguish from acute mastoiditis, especially when the posterior wall of the meatus is involved. Careful examination will disclose a localized swelling which in many cases is discharging pus.

Treatment.—Hot fomentations to the auricle and

syringing the meatus with warm lotion help to relieve the pain in the early stages. Incision of the furuncle is often called for.

Exostoses.—These occasionally grow from the bony wall of the meatus, and treatment is inadvisable unless they cause deafness. Owing to their extreme hardness, removal even by an electric burr may be exceedingly difficult.

Cerumen.—Plugs of wax often collect in the meatus causing deafness, which may become worse after bathing as the result of the moistened wax swelling up and occluding the meatus. Giddiness, vomiting and noises in the ear are symptoms resulting from pressure of wax on the tympanic membrane.

Treatment.—Drops of warm hydrogen peroxide (10 vols.) or a weak solution of bicarbonate of soda should be instilled at frequent intervals into the meatus to soften the plug, which can then be removed by syringing with warm water.

A metal ear syringe should be employed and the stream directed along the roof of the meatus.

Rupture of Tympanic Membrane.—This may be due to direct or indirect violence. In the former case, introduction of foreign bodies or unskilful attempts at their removal is responsible. Indirect violence acts by sudden compression of air in the meatus—*e.g.*, from a blow on the ear, heavy gun explosions or in diving. Fractures of the middle fossa of the skull are frequently associated with rupture of the tympanic membrane. Pain and deafness are complained of, and there may be a discharge of blood from the meatus. In most cases the membrane heals readily and restoration of hearing is complete. The meatus should be disinfected and a sterilized pad applied to the auricle.

Middle Ear.

It must be remembered that the middle ear comprises (a) the Eustachian tube opening into the nasopharynx, (b) the tympanic cavity, (c) the attic, (d) the aditus, (e) the mastoid antrum and mastoid air cells.

Otitis Media.—Inflammation of the middle ear

is extremely common and due in practically all cases to extension of infection from the naso-pharynx through the Eustachian tube. The organisms responsible are usually pneumococci or the pyogenic cocci. Children with adenoids are especially prone to otitis following a common cold, scarlet fever or measles. For convenience, cases may be divided into acute and chronic, catarrhal and suppurative.

1. **Acute Catarrhal.**—Earache, of a persistent and boring nature, deafness and fever are present, and on examination the membrana tympani may be injected and swollen, or red and bulging. The condition may subside in a few days or the membrane burst, discharging muco-purulent fluid into the meatus, with relief of symptoms.

Treatment.—In the early stages confinement to bed, light diet, ample fluid and regulation of the bowels are necessary. Chemotherapy by the sulphonamides is clearly indicated and has proved successful in aborting the attack. Drops of carbolic acid (5 per cent.) in glycerine inserted into the meatus, hot fomentations or antiphlogistine to the external ear help to relieve the pain. Paracentesis of the membrana tympani (myringotomy) is called for when signs of bulging appear, and sometimes earlier for the relief of pain. A general anæsthetic should be employed and the membrane incised with a special knife (myringotome) just behind the handle of the malleus; the incision is made from below upwards and a sterile dressing placed over the auricle. A linear incision of this type heals more readily than a rounded perforation and hearing usually becomes normal within two to three weeks.

2. **Acute Suppurative.**—This is a more serious type, pus formation being of rapid development. In addition to earache and deafness, pain and tenderness over the mastoid process are present in the early stages; both may subside after rupture of the tympanic membrane. Intracranial complications such as labyrinthitis, extradural abscess, lateral sinus thrombosis and meningitis are liable to occur in spite of the absence of mastoiditis.

Treatment.—In this type the membrane has often ruptured before the case is seen, but paracentesis may still be advisable if the perforation is small and does not allow free drainage. Other indications for myringotomy are severe pain and bulging of an intact membrane or marked fever with signs of cerebral or labyrinthine irritation. In all cases the meatus should be kept as clean as possible, some authorities advising gentle syringing, others suction with a Siegle's speculum.

Acute Mastoiditis.—The mastoid process contains

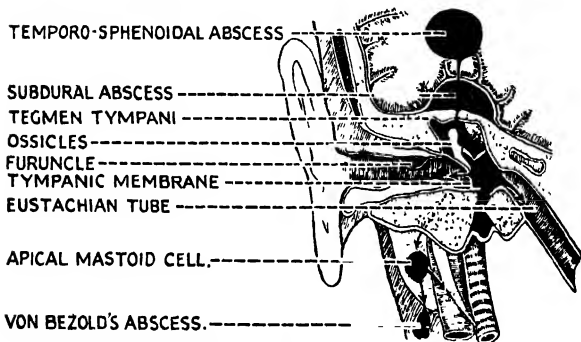


FIG. 33.—ILLUSTRATING COMPLICATIONS OF MIDDLE-EAR DISEASE.

the mastoid antrum, a cavity communicating with the attic by an opening (aditus) situated in the posterior wall of the tympanic cavity. By the fourth year the entire mastoid may have become hollowed out by the formation of air cells (cellular type comprising 80 per cent.) or dense bone may be laid down around the antrum, which remains of small size (acellular type). It is in the cellular type that mastoiditis usually develops by spread from the tympanic cavity, the aditus becoming blocked and allowing accumulation of pus under tension in the antrum and air cells. The pus may (a) burst through

the outer wall of the mastoid process and form a fluctuating swelling which displaces the auricle forwards, downwards and outwards; (b) burst through the inner wall of the process, giving rise to an abscess deep to and in front of the sterno-mastoid (Bezold's mastoiditis or abscess); (c) track backwards and give rise to an abscess between the mastoid process and the wall of the lateral sinus (perisinous abscess); (d) spread upwards through the roof of the antrum or the tympanic cavity, forming an extradural abscess in the middle fossa.

Signs and Symptoms.—The spread of infection to the mastoid air cells, especially if the aditus becomes blocked, results in an aggravation of both general and local symptoms. Pain in the ear is intensified, often extending to the mastoid region, and the marked tenderness over the mastoid is followed by swelling, redness and œdema. In many cases discharge from the ear ceases temporarily, but the general condition soon deteriorates, and rigors, irritability and drowsiness frequently supervene.

Treatment.—Free drainage of the mastoid antrum by Schwartze's operation is called for in the following cases of otitis media: (1) Persistence or recurrence of mastoid tenderness or pyrexia, after free drainage has been insured via the tympanic membrane. (2) Œdema or a fluctuating swelling over the mastoid process or the appearance of a Bezold's abscess. (3) Facial paralysis arising during a case of acute otitis media. (4) Symptoms of labyrinthine or intracranial irritation or infection—*e.g.*, giddiness, vomiting or nystagmus. (5) Persistent discharge from the ear after six to eight weeks of assiduous local treatment if skiagrams reveal infection of the mastoid air cells.

Chronic Otitis Media.—May be catarrhal or suppurative.

1. **Catarrhal.**—Is responsible for many cases of deafness coming on gradually without obvious cause during adult life. Increasing deafness is sometimes associated with tinnitus, the former becoming worse after a cold. The condition is due to fibrosis of the

lining of the tympanic cavity and Eustachian tube from repeated attacks of infection, the patient often having suffered from adenoids at an early age.

2. **Suppurative.**—May be confined to the Eustachian tube and tympanic cavity, but in most cases the mastoid antrum and process are also involved. Discharge from the ear, varying in amount from time to time, deafness, tinnitus and in some instances vertigo are present. Most cases are the result of an acute attack of otitis media, more particularly during the infectious fevers. It cannot be too strongly stressed that skilled treatment of acute otitis media would prevent the vast majority of cases of chronic middle-ear disease and otorrhœa.

Treatment.—(1) Attention to the general health by tonics, residence in fresh air and avoidance of colds. (2) Local treatment to the nose and naso-pharynx combined with removal of diseased tonsils and adenoids. (3) Free drainage of the middle ear by syringing of the auditory meatus, combined with hydrogen peroxide drops if the secretion is inclined to be viscid and dry up. Inflation of the Eustachian tube by Politzer's method or the passage of a Eustachian catheter assists drainage into the naso-pharynx. If the discharge persists in spite of these measures, it indicates the presence of some complication for which operative treatment is required.

Complications.—(1) Furunculosis and eczema of the external ear. (2) Aural polypus, consisting of granulation tissue, which arises from the inner wall of the tympanic cavity and protrudes through an opening in the membrana tympani, blocking the auditory meatus. Removal by snare or curette and cauterization of the base with a saturated solution of chromic acid may be tried, provided a fistula in the underlying bone has been excluded. It must be remembered that polypus formation usually means that the disease is deep-seated and the mastoid antrum involved. (3) Caries and necrosis of the temporal bone, especially the thin roof of the tympanic cavity (tegmen tympani). Bare bone may be felt, the discharge is foul and granulations prominent, operative treatment being

called for. (4) Cholesteatoma formation. These pearly masses are due to accumulation of epithelial cells bacteria and secretion, and may erode the bony walls of the cavity in which they are formed as they increase in size. (5) Facial paralysis. Fibrosis and thickening of the bone surrounding the aqueductus Fallopii cause pressure on the facial nerve, as it lies immediately behind the tympanic cavity and to the inner side of the aditus. The nerve may be actually exposed as the result of necrosis, especially in tuberculous cases. (6) Ankylosis or destruction of the auditory ossicles may lead to impaired hearing. (7) Intracranial disease—viz., extradural abscess, meningitis, lateral sinus thrombosis and cerebral or cerebellar abscess.

Indications for Radical Mastoid Operation:

1. Caries or necrosis of bone.
2. Facial paralysis.
3. Tuberculous disease.
4. Cholesteatoma formation.
5. Mastoid fistula.
6. Intracranial complications.

Labyrinthitis.—Due to spread of infection to the internal ear, either through the foramen ovale, foramen rotundum or the wall of the external semicircular canal. Vertigo, nystagmus and vomiting are signs that the semicircular canals are involved, whereas tinnitus and complete deafness are due to cochlear disease.

Otosclerosis.—A disease of unknown origin occurring in young adults and causing deafness, which may be progressive throughout life. The stapes becomes fixed in the foramen ovale, the membrane filling the foramen rotundum is ossified and the bony tissue of the labyrinth spongy. Bacterial infection does not appear to play any part and treatment is of no avail.

Ménière's Disease.—In this, tinnitus vertigo nausea and vomiting are accompanied by deafness, the condition being due to severe irritation or infection of the labyrinth.

Vertigo.—Giddiness may be due to widely differing causes—nervous, ocular, nasal, intestinal, toxic and aural. Causes in the ear itself are (1) wax in the external meatus; (2) Eustachian catarrh; (3) otosclerosis; (4) otitis media, acute and chronic; (5) labyrinthitis.

CHAPTER XXX

AFFECTIONS OF THE NECK

Injuries of the Neck.

1. **Subcutaneous.**—These may be due to violent blows, attempts at murder or suicide, or to run-over accidents. If serious bleeding among the cervical muscles follows, interference with breathing or swallowing may supervene; and if the larynx or trachea is injured, rapid onset of œdema of the glottis may necessitate immediate tracheotomy. Often the suffocative symptoms supervene more gradually and surgical emphysema may develop. Rupture of the œsophagus entails a virulent form of spreading infection which needs early free incisions. If the hyoid bone or laryngeal cartilages are broken the patient complains of intense pain, there is difficulty in swallowing and breathing, with blood-stained frothy expectoration. If breathing becomes more laboured in spite of injections of atropine and local spraying with adrenalin, tracheotomy is inevitable.

2. **Penetrating.**—These may be *punctured* when caused by a stiletto or any dagger-like instrument. They are inflicted usually with homicidal intent, and when well directed open up the main vessels at the root of the neck, with rapidly fatal effects. In other cases the air or food passages may be damaged or even the spinal cord severed. More commonly suicidal or homicidal injuries are *incised* and constitute *cut-throat*. If right-handed, the would-be suicide cuts from left to right, the wound being deepest at the beginning and shallow at its end. It also slopes upwards from left to right; the reverse applies to left-handed

attempts. The taut sterno-mastoid muscles may protect the great vessels of the neck, but the air passages are often involved and bleeding from the large superficial veins may be serious, even when the wound itself is not extensive. The direction of homicidal wounds depends on whether inflicted from behind or in front, but in general they are transverse, of uniform depth, and on the whole more severe than suicidal wounds.

Wounds involving the Air Passages.—May be above the hyoid, through the thyrohyoid membrane, into the larynx or trachea.

Immediate Effects.—Due to hæmorrhage, suffocation or entry of air into large veins. If *suprahyoid* (rare) there is danger of (1) hæmorrhage from the facial and laryngeal arteries, (2) suffocation from falling back of the severed tongue or epiglottis. The commoner type involves the *thyrohyoid membrane*, hæmorrhage arising from lingual, facial and superior thyroid arteries; the pharynx may be opened, the arytenoid and epiglottic cartilages injured, but the great vessels escape as a rule. When the *larynx* is involved hæmorrhage is seldom severe, and unless the vocal cords are directly injured or blood trickles into the trachea serious effects are unlikely. In *tracheal* wounds the great vessels are often severed, rapidly fatal hæmorrhage being the rule; if not, displacement of the severed tracheal ends, damage to the recurrent laryngeal nerves, and injury to the infrahyoid muscles determine rapid asphyxia.

Secondary Effects are mainly inflammatory.

1. Septic cellulitis of the neck, œdema of the glottis, secondary hæmorrhage and pyæmia.

2. Septic broncho-pneumonia from inhalation of infected discharges, decomposing blood clot, food debris, etc.

3. Surgical emphysema.

Treatment.—Control of hæmorrhage is the prime necessity. If this can be secured by plugging or otherwise an anæsthetic should then be given, the wound thoroughly opened up, every bleeding vessel secured, non-viable lacerated tissue excised and a tracheotomy tube inserted whenever the larynx or

trachea is seriously damaged. In suprahyoid and thyrohyoid wounds the tube may usually be dispensed with, but the epiglottis should be stitched accurately if severed. Blood, etc., must be aspirated from the lungs if asphyxial symptoms persist, and in all cases the wound thoroughly excised, united in layers and freely drained. Provision for tracheotomy is desirable when this has not been done as an urgency.

Sequelæ—An *aerial fistula* may follow, necessitating a plastic operation for its repair. *Laryngeal* or *tracheal* stenosis may be most intractable, and a permanent tracheotomy may be inevitable if more direct measures fail. Aphonia and voice changes are the outcome of division of the recurrent laryngeal nerve and, if both nerves are cut, may be associated with intense dyspnoea on exertion.

The *thoracic duct* may be divided in cut-throat wounds or during surgical operations; if not treated by immediate ligation a profuse discharge of milky fluid flows from the wound and the patient may waste rapidly, but spontaneous cure often follows; opening up of the wound and careful ligation of the leaking duct will invariably suffice for cure.

Solid Tumours of the Neck—1. *Innocent*.—A single lipoma may develop anywhere in the neck; the diffuse variety is met with in men who consume an excessive amount of malt liquors. Fibroma, osteoma (from the hyoid bone or vertebræ), chondroma (from the laryngeal cartilages) all occur occasionally, as do also mixed-celled tumours arising independently of, but resembling in structure those from the salivary glands.

2. *Malignant*.—Epithelioma of the skin is not unusual and has the same characters as in other sites. Apart from the numerous instances of secondary malignant glands associated with epithelioma of the lip, tongue and larynx it is relatively common to find secondary deposits in the left supraclavicular group associated with intra-abdominal malignant disease (Virchow's gland).

Branchial Carcinoma.—A hard primary squamous-celled growth appearing in the upper part of the neck

under the sterno-mastoid. It is frequently confused with the more common condition in which a mass of secondary malignant glands appears in the neck long before there is gross evidence of any primary lesion; this, indeed, may be so minute in size and so obscurely situated as to escape detection until autopsy. Branchial carcinoma has also been stated to develop in the walls of a branchial cyst.

Lympho-sarcoma.—Arises in the tonsil or the lymphatic glands, is soft, spreads rapidly, reaches a large size and, unlike branchial carcinoma, is radio-sensitive.

Tumours of the Carotid Body.—These are rare. Occasionally they spread slowly and behave as innocent peritheliomata, but usually are very malignant, growing from the deep aspect of the bifurcation of the common carotid. They are often called *potato tumours* because of their resemblance on section to a raw potato. The common carotid and its two branches become deeply embedded in the tumour, which is markedly movable transverse to the direction of these vessels, but fixed in their longitudinal axis. Nerves and muscles are eventually infiltrated, but metastasis is rare. Complete extirpation often necessitates interference with the common carotid artery and its branches, frequently leading to changes in the cerebral circulation and consequently both mental and physical disabilities.

Branchial Fistulæ.—These originate in remnants of the third branchial pouch, and if complete, extend from the pharynx behind the tonsil to open externally in front of the sterno-mastoid tendon a short distance above its insertion. They may be unilateral or bilateral, are lined by ciliated epithelium, and secrete a mucoid fluid which discharges on the surface. More often this fistula is represented by its lower end only, and is then more correctly termed a *cervical sinus*. The proper treatment is the excision of the whole track after raising a suitable flap of superficial tissues. The track of the fistula or sinus, being thick-walled, can usually be identified with ease. Even if complete there is rarely any great difficulty in following it upwards and isolating it as it passes between the two

main branches of the common carotid, finally applying a ligature as close to the pharyngeal wall as possible. Lipiodol injection combined with skiagrams, and the instillation of dyes which stain the mucosa, will establish the extent of the track both before and during the operation.

Branchial Cysts.—Probably of similar origin to the above. They may occupy sites corresponding to any part of the fistulous track already indicated. They lie at first beneath the anterior border of the sterno-mastoid, but as they increase tend to burrow deeply under cover of it. They vary in size from time to time, rarely appear before puberty, are soft, fluctuating, rounded or ovoid; their walls, which vary in thickness, frequently contain lymphoid tissue, and the contents are thick and sebaceous with abundance of cholesterin crystals, or thin and mucoid in character. Usually they can be excised without difficulty owing to the absence of adhesions to important structures, but those situated most deeply and highest in the neck are sometimes thin-walled and adherent to the styloid or mastoid processes.

Branchial carcinoma originates in remnants of branchial cysts and fistulæ, hence the desirability of complete extirpation of such abnormalities.

Cysts of the Neck—I. CONGENITAL.—(1) *Branchial* (see above).

(2) *Cystic Hygroma (Hydrocele of Neck)*.—Of congenital origin, though not often seen until the child is a few years old, it forms a flaccid, lobulated, translucent, cystic swelling usually low down on one side of the neck. The skin is often nævoid and atrophic over the main prominence, and attacks of lymphangitis are not uncommon. Treatment is by complete extirpation, which is facilitated if undertaken before inflammation has supervened. Usually the mass must be carefully dissected off the carotid sheath and brachial plexus, to which it is often adherent.

(3) *Dermoid Cysts* are sequestrations of the skin and appear at any age in the mid-line of the neck at all levels from the chin to the sternum. They are rounded, free from attachment to the skin or deeper

tissues, containing sebaceous material and sometimes a few hairs. Complete extirpation is advisable and not difficult.

(4) *Thyroglossal Cysts*.—These arise in unobliterated remnants of the thyroid anlage, which extends from the foramen cæcum to the isthmus or to the pyramidal lobe of the thyroid; in its course it passes in front of, but closely apposed to, the body of the hyoid. If the suprahyoid part becomes cystic, a swelling of the tongue results; if the lower part is

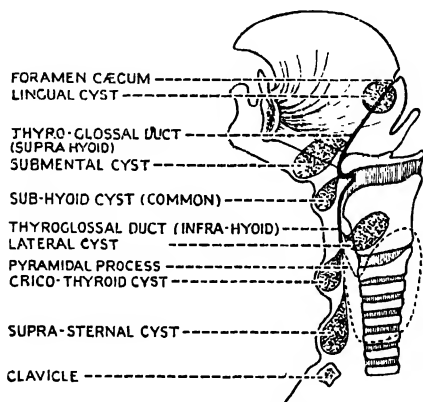


FIG. 34.—CYSTS IN CONNEXION WITH THE THYRO-GLOSSAL TRACT.

affected, a rounded median swelling appears a year or two after birth (rarely, much later) just below the hyoid and grows slowly. Suppuration may supervene and a fistula often forms having a characteristic crescentic fold of skin above its orifice. Treatment is by complete extirpation, if necessary resecting the median part of the hyoid bone to facilitate access to the buccal extremity of the track.

2. ACQUIRED—(1) *Sebaceous Cysts*.—These are common especially at the nape.

(2) *Bursal Cysts*.—These lie between the hyoid bone and thyroid cartilage. They are distinguishable from thyroglossal cysts by being painful, elongated transversely to the neck, lined by endothelium and appearing later in life. Excision is indicated.

(3) *Serous Cysts* may be due to dilatation of lymphatics or to the unilocular type of cystic hygroma.

(4) *Blood Cysts* are due to hæmorrhage into an angioma or from a vein.

(5) *Degenerative Cysts* arise in connexion with secondary carcinomatous deposits in lymphatic glands, or in association with thyroid or salivary gland tumours.

(6) *Hydatid Cysts* may appear in many cervical sites.

(7) *Cysts due to distension* of the lateral laryngeal or pharyngeal recesses. They may contain air.

DISEASES OF THE THYROID GLAND

I. Thyroiditis.

II. Simple goitre.

III. Neoplastic goitre.

IV. Toxic goitre.

V. Hypothyroid states.

I. Thyroiditis—1. **Acute**.—This may be suppurative or non-suppurative, and may occur during the course of or following an attack of one of the specific fevers or other infections. The usual signs of inflammation are present, but early pus-formation may not be easy to detect. Free incisions are desirable as soon as pus is suspected. Sulphonamide therapy may abort suppuration if administered early.

2. **Chronic**—(a) *Tuberculosis*.—The miliary type is invariably associated with fatal generalized infection. The caseous type is uncommon, but amenable to treatment by resection of the affected part of the gland. Thyrotoxic symptoms (see p. 360) are frequently exhibited by this variety.

(b) *Syphilis*.—Gumma of the thyroid may occur both in the inherited and acquired forms of the disease. A hard mass appears in one lobe and pressure effects are common, with a tendency to involvement of

the recurrent laryngeal nerve and other extrathyroid structures. Antisymphilitic treatment usually produces rapid cure, but if not the affected region should be explored to eliminate the possibility of malignant disease.

(c) *Riedel's Disease (Ligneous Thyroiditis)*.—A rare disease affecting both sexes, originating in one lobe and slowly spreading to the remainder of the gland. The pathological process appears to be a dense fibrosis invading and replacing the normal tissues and invariably spreading to the extrathyroid structures, which become adherent to the gland. Eventually the fibrotic process may embrace the carotid sheath and attain the base of the skull. Obstruction to both the trachea and gullet is common. Myxœdematous sequelæ are extremely rare.

(d) *Hashimoto's Disease*.—This differs from the preceding in affecting the whole thyroid uniformly and in being strictly limited to the gland, which is never as hard as in Riedel's disease. Myxœdema is a common sequela. Operative treatment is undesirable except to relieve pressure symptoms, which fortunately are seldom pronounced. Teleradiation is said to be effective in small or moderate dosages.

(e) *Hydatid Disease* may affect the thyroid in districts where the echinococcus is prevalent. The cyst is nearly always unilocular, tends to cause severe pressure effects, and may burst into the trachea. Extirpation of the whole cyst, or failing this marsupialization, is indicated.

II. Simple Goitre occurs as an *endemic* and as a *sporadic* disease.

The pathological nature of the goitre in both types is essentially similar and in neither is it neoplastic. Rather it is to be considered as due to varying degrees of degeneration or hyperinvolution in thyroid glands which have been under the influence of adverse factors, such as prolonged over-stimulation, defective or ill-balanced diet, infective processes, and in certain endemic varieties, iodine deficiency in the soil. Water pollution may be responsible for certain epidemics of goitre, but cannot be the cause of simple goitre gener-

ally. Climatic conditions, the geological structure of the district, and many other factors have in the past been blamed for simple goitre, but none of them has been found to accord with what is known as to the natural history and distribution of the disease. Prolonged inbreeding is certainly important in maintaining endemic goitre.

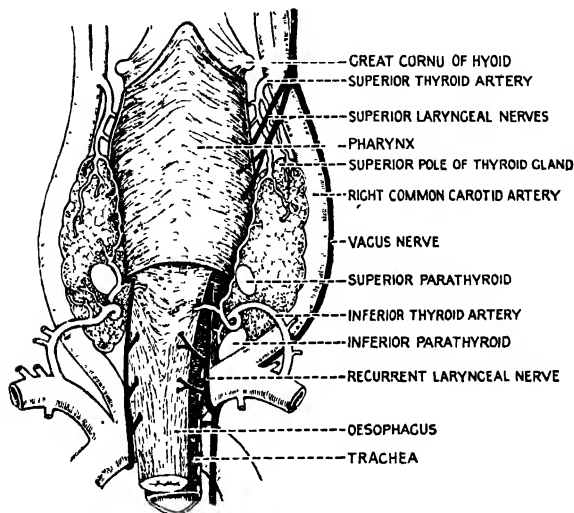


FIG. 35.—ILLUSTRATING SURGICAL ANATOMY OF SIMPLE GOITRE (POSTERIOR VIEW).

Note outward displacement of carotid artery and close proximity of recurrent laryngeal nerves.

Varieties.—(1) Parenchymatous, (2) colloid, (3) nodular or adenomatous.

1. *Parenchymatous goitre* is rare and found only in those districts where endemic goitre has persisted through many generations. Infants and children are usually affected, the gland is diffusely enlarged and firm, and consists mainly of tightly packed thyroid

vesicles without colloid content. It must be carefully differentiated from the much commoner colloid variety.

2. *Colloid* goitre is the commonest type at puberty and in early adult life. Often of trivial size, it may attain enormous dimensions and produce bilateral compression of the trachea. Pathologically it consists of thyroid vesicles distended with colloid, the size of the goitre being closely related to the extent of this colloid storage. The lesser degrees may disappear without special treatment, the larger goitres, however, eventually becoming converted into:—

3. *Nodular* or "*Adenomatous*" goitre, the structure of which often clearly indicates its origin from the diffuse colloid type. The change may be localized (single adenoma) or diffuse (nodular goitre, often erroneously termed adeno-parenchymatous). Cystic, calcareous, osseous, hyaline, fibrous, granular, amyloid and other degenerations are common, and pressure effects are produced dependent on the degree of compression displacement or torsion of the trachea. Substernal or intrathoracic varieties are met with, and toxic transformation—**secondary toxic goitre**, '**toxic adenoma**'—is frequent in long-standing cases. Adenomata may be mainly parenchymatous in structure, in which case they are often referred to as of the foetal type (Wölfler's tumour) or they may be largely colloid in structure, but combinations of the two types are not uncommon. Certain malignant goitres appear to arise more commonly in goitrous districts—*e.g.*, **malignant adenoma**.

Thyroid cysts are almost invariably the result of liquefaction of solid nodules and may follow intranodular hæmorrhages.

Treatment—1. *Prophylactic*.—In certain endemic areas, but not in all, the administration of iodine to pregnant women or the regular use by school children of iodized salt or sweetmeats containing iodine may materially diminish the incidence of the disease. Elimination of in-breeding in isolated goitrous districts may eventually prove to be the most valuable prophylactic measure.

2. *Curative*.—Parenchymatous goitre proper is amen-

able to iodine therapy combined with a full vitamin diet and exposure of the patient to ultra-violet rays or sunlight. Colloid goitre in its lesser degrees frequently disappears without treatment. If it is growing rapidly or causing severe dyspnoea, portions of both lateral lobes should be removed. Nodular goitres are not influenced by drugs or by deep X-ray therapy, and should be treated by unilateral or bilateral resection, or resection-enucleation of the pathological tissue. Sufficient of the gland must be conserved for secretory purposes and the thyroid tissue in the immediate neighbourhood of the parathyroid glandules and recurrent laryngeal nerves carefully respected.

Intrathoracic and Substernal Goitre.—Colloid goitre often extends downwards behind the clavicle on one or both sides, but this seldom has any important influence on the case except in so far as tracheal compression is more likely to be pronounced. In nodular goitres a portion of one lateral lobe may extend below the first rib as far as the aortic arch or even displace this downwards; occasionally the condition is bilateral. If the cervical tumour is small and the intrathoracic large this constitutes an *intrathoracic* as distinguished from a *substernal goitre*, in which the thoracic portion is small compared with the cervical. Intrathoracic goitre may possibly arise in aberrant thyroid tissue. In most intrathoracic goitres the part within the thorax is too large or too fixed to rise with efforts at deglutition. Skiagrams reveal these goitres as rounded masses, sometimes exhibiting calcareous areas, displacing the trachea laterally, causing various distortions of its lumen or even compressing it antero-posteriorly. The oesophagus may be affected similarly though less seriously. The great veins are occluded and large collateral venous plexuses may form over the upper part of the thoracic wall. A dry spasmodic irritable cough, often nocturnal, develops and bronchitis is common. Treatment is essentially surgical. Intratracheal anæsthesia is desirable. The goitre can usually be drawn upwards into the neck after controlling the thyroid vessels, for there are no important vascular connexions between the in-

trathoracic portion and its bed. Special instruments may be required to enable the mass to be elevated, but with cystic or soft nodular swellings it is permissible to reduce their bulk by introducing a finger into the interior, allowing the contents to escape. In malignant intrathoracic goitre the manubrium sterni may need to be divided before removal is possible.

III. Neoplastic Goitre—1. *Simple*.—Papilloma, dermoid cysts and fibroma have been recorded.

2. *Malignant*—(i.) *Epithelial*.—The commonest type is the **malignant adenoma of Langhans**, which develops insidiously in a nodular goitre. It invades the blood stream, and gives rise to distant metastases, often of a vascular pulsating character in the skull and other bones, but seldom involves lymphatic glands. Clinically, before metastasis there is nothing which indubitably stamps a malignant adenoma as such, and this fact alone stresses the advisability of removing all nodular goitres. **Papilliferous adenocarcinoma** is less common but more benign in its course. It may originate in **aberrant or ectopic thyroid tissue** and is sometimes apparently polycentric. Glands may be involved, but the blood stream is seldom invaded. Local recurrence after operation is usual, but may be long-delayed, and this fact justifies repeated attempts at extirpation.

Benign Metastasizing Goitre.—The tendency shown by some forms of malignant adenoma to give rise to single metastases, mainly osseous, which are highly differentiated in structure and capable of producing thyroid hormone, has led to the view that these are non-malignant, but their destructive effect on the bony tissue as well as their eventual spread to other structures disproves this.

Carcinoma Simplex also occurs, but less often in nodular goitre than in glands primarily normal in size. The disease is much more serious than either of those described above, for it quickly invades surrounding tissues, infiltrates the trachea and oesophagus, and while having only a moderate tendency to dissemination, is rapidly fatal from its local effects. Radical surgical measures, including block

extirpation of the lymphatic tissues, sterno-mastoid and internal jugular vein, offer only a slender chance of cure.

Squamous carcinoma, which may be *primary*, and is then due probably to metaplasia of the thyroid epithelium, is more commonly *secondary* and due to invasion of the thyroid by growths of the cervical œsophagus or hypopharynx. The smooth outline of the latter differentiates it from the former and œsophagoscopy reveals the primary growth.

(ii.) *Connective Tissue*.—**Sarcoma** is much less common than carcinoma, but all histological varieties occur, especially one consisting of round and spindle cells with numerous intermediate cell types and extensive leucocytic infiltration. **Endothelioma** and **hæmangio-endothelioma** are also described, as well as tumours containing cells which at one site resemble epithelial elements and at another connective tissue—**carcinoma sarcomatodes**—but it is probable that all these changes are the result of metaplasia in the original epithelial cells.

(iii.) *Teratoma*.—Usually a congenital tumour which may be large enough to produce dystocia. Cells of both epiblastic and mesoblastic origin, glandular, muscular and nervous elements may be present.

Diagnosis of malignant goitre depends on the recognition of rapid growth, alteration in the consistence of an existing goitre, unusual degree of dysphagia or dyspnœa, early involvement of recurrent laryngeal and cervical sympathetic nerves, and pain in the head or ear.

Treatment.—In addition to operative treatment as outlined above, many forms of malignant goitre, both epithelial and connective tissue, as well as their metastases, are very radio-sensitive; therefore X-ray therapy should be given a trial after operation, when this has been possible, and also in inoperable cases.

IV. Toxic Goitre (Thyrotoxicosis).—This term is applied to all forms of goitre associated with evidence of a perverted or excessive thyroid secretion, or both. It is usual to differentiate between *Primary Toxic*

Goitre (Graves' disease, Basedow's disease, or exophthalmic goitre) and *Secondary Toxic Goitre* or '*Toxic Adenoma*,' although the distinction is probably not fundamental. The main differences which distinguish these forms are shown below:

<i>Primary Toxic Goitre.</i>	<i>Secondary Toxic Goitre.</i>
Onset often rapid.	Onset generally insidious.
Young adults frequently affected.	Middle-aged goitre bearers affected.
Exophthalmos in two-thirds of the cases.	Exophthalmos rare and never pronounced.
Nervous excitability common.	Nervous phenomena unusual or slight.
Myocardium not affected early.	Myocardial and vascular degeneration characteristic.
Metabolic disorders common. B.M.R. often very high.	Metabolic disorders less common. B.M.R. seldom raised more than 50 per cent.
Gastro-intestinal crises common.	Gastro-intestinal crises rare.
Goitre symmetrical; rarely very large.	Goitre usually nodular and sometimes enormous.
Diffuse hypertrophy and hyperplasia of epithelial cells is characteristic.	Cellular hypertrophy and hyperplasia may be entirely lacking or may occur irregularly distributed in nodules and internodular tissue.
Anæmia rare. Often iodine therapy has profound effect.	Anæmia common. Iodine rarely has dramatic influence.
May progress rapidly and end in delirium and coma.	Disease more chronic and death usually due to myocardial lesions.
Operation risks considerable.	Operation risks less.
Operative cures 90 per cent.	Operative cures 100 per cent.

Primary Toxic Goitre, or *Exophthalmic Goitre*, is in Britain nine times as common in women as in men, and often appears after an attack of influenza or sudden shocks or frights, but the way in which these factors influence the thyroid gland is quite obscure. It is usually a chronic disease, with a tendency to acute exacerbation. Many, but not all, of the phenomena of the disease are compatible with the hypothesis that it is due to an excess of thyroid secretion in the tissues—*i.e.*, hyperthyroidism. The most serious forms of the disease are associated with extreme nervousness, excitability,

rapid wasting and gastro-intestinal crises. The gland is uniformly enlarged, but whereas the goitre may be large, pulsating and highly vascular, it is sometimes so small as to be detected with great difficulty (*masked hyperthyroidism*). Exophthalmos, if present, is usually bilateral, and numerous ocular signs have been described, including von Graefe's, Stellwag's, Dalrymple's, etc., but they are not strictly of diagnostic or prognostic value. There is invariably a rise in the *Basal Metabolic Rate* as compared with that normal to the individual. By this means, as well as the effect of an intensive course of iodine therapy on the B.M.R., doubtful cases can often be confirmed. Recently a galactose-tolerance test has been found to have a value both in diagnosis and prognosis in thyrotoxicosis.

Prognosis.—A few cases gradually improve with rest, and these may lose the more serious symptoms in the course of a few years, but complete restoration to normal is unlikely. Many cases end in delirium and coma following an exacerbation of the disease.

Treatment—1. *Medical.*—Rest is valuable in all cases, but it may take several years before the disease is controlled, and it is often impossible by this method to check its progress. Iodine administered as Lugol's tincture (5 per cent.), 5 to 20 minims three times a day, will frequently produce a rapid amelioration of the symptoms and a fall in the B.M.R., but relapse sooner or later follows. There is little to be gained, as a rule, by prolonging iodine therapy beyond a fortnight. Digitalis is valuable only where there is evidence of cardiac failure. Administration of fluids by mouth and glucose (5 per cent.) intravenously, if necessary, are helpful, especially when wasting is rapid. Insulin may be useful as an adjunct or to control diabetes. Sedatives such as potassium bromide, chloral hydrate and valerian may be required to allay excitability. Physostigmine, belladonna and fluorides have been advocated, but on the slenderest grounds. Thyroid-ectin and rhodagen are utterly discredited remedies.

2. *Radiological.*—Radium applied externally by means of a moulded applicator or by a 'bomb,' or internally by needles or radon seeds have all been

tried. Some cases have benefited, others are unaffected or harmed by the treatment. X-ray therapy is considered by many to be valuable. It is claimed to cause fibrosis in the gland and thus reduce its activity. No pathological evidence of any such influence is forthcoming, but, nevertheless, it is worthy of trial for a limited period at an early stage when operation is refused.

3. *Surgical*.—If properly prepared by iodine therapy, etc., over 90 per cent. of cases of less than twelve months' standing can be cured by the removal of approximately seven-eighths of the gland. The mortality ought not to exceed 1 per cent. Cases of longer standing and with visceral lesions—*e.g.*, cardiac, hepatic and pancreatic—are fraught with greater risks. Preliminary ligation of the superior thyroid artery under local anæsthesia may help to reduce the activity of the gland and the danger of subsequent thyroidectomy, which in certain grave cases should be done in stages. Success in surgical treatment depends on careful selection of the phase of the disease suitable for intervention, perfect technique and assiduous post-operative care.

(1) *Preparation of the Patient*.—A preliminary period of rest, with abundance of fluid and easily absorbable foodstuffs to counteract the tendency to wasting, is essential. A course of sedatives such as the bromides or luminal is often desirable, and in all cases iodine in the form of the French tincture or di-iodo-tyrosine tablets should be administered for approximately fourteen days before the operation. Digitalis is not advisable unless indications of congestive heart failure are present, and even in these it is better to omit the drug for a day or two before the actual operation.

(2) *The Anæsthetic*.—For routine purposes gas and oxygen anæsthesia, combined with local infiltration with $\frac{1}{2}$ per cent. novocaine (not exceeding 200 c.c.) and preceded by a small dose of morphine with atropine, is the safest and most reliable method. Basal anæsthesia with avertin combined with local infiltration is indicated in excitable patients, but

morphine must be avoided in this connexion. Penthathal or evipan may sometimes be preferable to other pre-anæsthetics, but in all serious cases the minimal effective dose should be aimed at. Ligation of arteries can be carried out with local infiltration preceded by morphine and atropine, but for the complete operation it is seldom desirable to rely upon purely local anæsthetic measures.

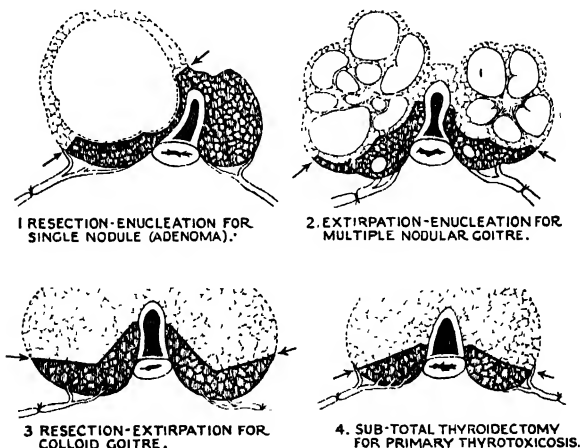


FIG. 36.—OPERATIONS FOR GOITRE, ILLUSTRATING AMOUNT OF GLAND REMOVED AS SEEN IN TRANSVERSE SECTION.

Note (1) Sites of ligation of inferior thyroid artery; (2) state of trachea.

(3) *The Operative Technique* necessitates gentleness and celerity with accurate hæmostasis. The latter can be achieved best by early control of the main arteries, all four of which should be ligated in primary thyrotoxicosis and at least three in the secondary form. Drainage of the wound is unnecessary with accurate hæmostasis. A symmetrical subtotal thyroidectomy is aimed at in the hyperplastic type of

gland, not more than one-eighth of each lobe being conserved.

(4) *Post-operative Treatment.*—The serious-risk cases are helped by being treated for several hours after the operation in a tent, 'B.L.B.' mask or chamber with an atmosphere of 50 per cent. of oxygen or more. Saline with glucose (5 per cent.) is essential by subcutaneous, oral, rectal or intravenous routes, and in the last two preferably by the continuous-drip method. Large doses (50 minims) of Lugol's solution are sometimes advantageous for the first forty-eight hours, and sedatives may need to be pushed, though morphine derivatives are not free from danger. Strophanthin intravenously is often superior to digitalis if auricular fibrillation asserts itself, and quinidine may be necessary later to treat persistent cardiac irregularity. Cold sponging and ice-bags, if employed judiciously, help to control restlessness in certain subjects, and a steam kettle is often required to allay the troublesome cough associated with post-operative tracheitis.

The main sequelæ to be feared are myxœdema (*q.v.*), hoarseness due to damage to the recurrent laryngeal nerve which may be complete, when it is usually permanent, or incomplete, when it is often temporary. Tetany is rare if the parathyroid glandules are protected by preserving the posterior part of the thyroid lobes. Should it, however, supervene, the patient notices numbness and tingling in the forearms, followed by carpo-pedal spasms and difficulty in swallowing. Treatment is by the exhibition of large doses of calcium by the mouth or intravenously, and by a diet rich in calcium and poor in phosphates, reserving parathormone (the active principle of the parathyroid) for the acute stage or for severe forms. Excellent results also follow the use of vitamin D₂ (calciferol). Parathyroid grafts have been employed successfully.

V. Hypothyroid States.—These may occur congenitally in association with defective development of the thyroid gland, constituting *sporadic cretinism*, or in goitrous children in regions where endemic goitre is very prevalent, the thyroid gland being intensely

degenerate—*endemic cretinism*. In the former the thyroid deficiency is extreme, and gross physical and mental maldevelopments are characteristic; in the latter the mental and physical defects are not necessarily in proportion, and there is a wide variation in the intensity of the thyroid deficiency, some cases being so little abnormal as almost to escape detection, others exhibiting signs of the grossest thyroid hypofunction, together with such specialized lesions as deaf-mutism, goitre-heart, etc., which are not seen in the sporadic type. In-breeding throughout several successive generations appears to be of predominating importance in the causation of endemic cretinism.

Myxœdema.—This is a condition of deficient thyroid function which may arise spontaneously, especially in women over middle age, though not confined to this sex. Mental and physical torpor with alterations in metabolism and a peculiar thickening of the subcutaneous tissues due to the deposition of a mucinoid substance characterize the disease. The thyroid gland is found to be atrophic. A disease 'cachexia strumipriva,' with a similar syndrome, follows the total surgical removal of the thyroid gland, and it is also closely simulated by the complete functional destruction of the secretory tissues in certain diseases—*e.g.*, Hashimoto's disease. In cases following surgical extirpation, the onset is more rapid than in the spontaneous disease, but otherwise there are no essential differences.

Treatment.—All forms of thyroid deficiency respond to thyroid therapy, and the ideal to aim at is to give just enough of the active gland substance to maintain metabolism at a normal level. The preparation prescribed is usually obtained from the thyroid glands of sheep, and should be standardized to contain a proper percentage of iodine. In most cases the dose need not exceed 2 to 3 grains of the dry extract daily. If the remedy is omitted for more than a day or two the patient will begin to relapse into the myxœdemic state. Thyroxine, the active hormone of the thyroid gland, can also be used to

combat thyroid deficiencies, but it has no advantages over the usual pharmacopœial preparation and is more expensive.

Thyroid Grafting is sometimes employed with the object of providing a source of thyroid secretion within the body, but although a moderate proportion of temporary successes is claimed, no satisfactory proof of permanent cure is forthcoming. Numerous very small grafts are cut from the relatively healthy shell of thyroid tissue excised with adenomas or cysts during the operation of resection-enucleation, or from hyperplastic goitres in Graves' disease. They are inserted into the subcutaneous tissues, the spleen, or into hollows excavated in cancellous bone.

Total Thyroidectomy for some forms of angina pectoris and for congestive heart failure has a certain limited usefulness. The benefit is attributable to the fall in metabolism which ensues. The indications need careful scrutiny, for the patient will eventually exhibit hypothyroid features, sometimes of a pronounced type.

CHAPTER XXXI

AFFECTIONS OF THE AIR PASSAGES AND CHEST

The Air Passages.

Foreign bodies may be impacted in:

1. **Pharynx.**—Death from suffocation may result from bolting unmasticated food, which blocks the opening of the larynx. Incomplete obstruction (as from a denture) may cause great dyspnœa, and this is liable to increase owing to the onset of œdema of the larynx. During anæsthesia, epileptic fits or alcoholic coma, a mass of food may be vomited and block the entrance to the larynx.

Treatment consists in rapid removal with the finger or, if this is unsuccessful, laryngotomy followed by artificial respiration.

2. **Larynx.**—Partial or complete obstruction may be caused by such bodies as coins, pins or buttons.

Violent coughing, hoarseness and respiratory stridor mark incomplete obstruction, but œdema of the glottis may soon follow, rendering it complete.

Treatment consists in removal by the direct laryngoscope under local or general anæsthesia; on rare occasions it may be necessary to open the larynx by thyrotomy.

3. **Trachea.**—A small foreign body with jagged edges may pass through the larynx and become impacted in the trachea; if in the upper part, pain and incessant coughing follow, whereas at the lower end no symptoms may result. Violent attacks of dyspnœa and coughing may be produced by alteration in position of the foreign body due to the patient's movements. Frothy blood-stained expectoration from tracheo-bronchitis is liable to follow, especially with foreign bodies of a vegetable nature.

Treatment.—Removal should be carried out under direct vision with a Brüning's or Chevalier Jackson's tube. If these are not available and dyspnœa is urgent, tracheotomy should be performed and an attempt made at removal by any pair of forceps which can be passed into the trachea.

4. **Bronchus.**—Small and smooth bodies such as buttons, pebbles, orange pips, melon seeds or toy whistles are liable to become inhaled into a bronchus. The right bronchus is more often involved, being in a more direct line with the trachea and the lumen larger than that of the left. The symptoms may be classified as (a) obstructive, (b) irritative, (c) inflammatory. When the foreign body is inhaled there is usually an attack of spasm causing pain and coughing, but this is not always a prominent feature. A quiescent period follows in which the patient is more or less comfortable. Vegetable substances usually produce acute tracheo-bronchitis, with expectoration and pyrexia, within a few hours; non-vegetable bodies may remain *in situ* for months or years without producing any symptoms. Obstruction to the bronchus is at first incomplete and valvular, but becomes complete from œdema of the mucous membrane. Emphysema of the corresponding area of

lung is followed by collapse, with dulness and loss of breath sounds. Bronchiectasis, lung abscess and empyema are late results.

Treatment.—Accurate localization by stereoscopic skiagrams may be of value with opaque bodies; bronchoscopy should be employed for removal in all cases.

The Larynx.

Injuries.—The hyoid bone is fractured by direct lateral violence. Symptoms produced are pain on moving the tongue, jaw, or neck; alteration of the voice; and perhaps deformity. Bleeding into the pharynx and œdema of the glottis may follow. The neck should be fixed by a poroplastic collar after reduction by manipulation. The thyroid or cricoid cartilage may be broken by direct violence, as in garrotting. Cold applications should be applied to the neck unless dyspnœa becomes urgent from œdema of the glottis, when intubation or tracheotomy will be required.

Acute Laryngitis may be due to extension of infection from the nose or throat, or arise primarily in the larynx; exposure to cold and lowered resistance predispose to it. Perichondritis is liable to follow acute laryngitis complicating the infectious diseases. Pain in the laryngeal region, dry cough and hoarseness or aphonia are the typical symptoms. The patient should rest in a warm, well-ventilated room and avoid using the voice. Inhalations of Friar's balsam or oil of creosote in steam at frequent intervals are the most useful remedies. In severe types due to streptococcal infection chemotherapy with sulphonamides may be very effective.

Chronic Laryngitis is usually secondary to nasal catarrh or bronchitis, but may be primary and due to over-use of the voice, oversmoking or chronic alcoholism. The vocal cords may appear normal, but are usually thickened and pinkish, with secretion of mucus in the interarytenoid space. In the nodular variety, due to improper use of the voice, a small white nodule may be seen on the free margin of each

cord, at the junction of the anterior and middle thirds.

Pachydermia laryngis is found more commonly in men between the ages of thirty and sixty, predisposing causes being excessive smoking and alcoholism; thickening of the mucous membrane at the posterior ends of the cords and in the interarytenoid space is found, with no impairment of movement.

Hoarseness is the main symptom in all forms of chronic laryngitis.

Treatment.—Attention should be paid to the general health, and the nose, mouth, pharynx and larynx rested. The larynx may be sprayed with a solution of silver nitrate (2 to 5 grains to the ounce) or zinc sulphate (2 to 10 grains to the ounce).

Diphtheritic Laryngitis is usually an extension from faucial diphtheria, and may give rise to severe dyspnœa from obstruction to the glottis. If large doses of antitoxin do not give relief, intubation or tracheotomy may be required.

Œdema of the Glottis—*Causes.*—(1) Acute catarrhal laryngitis or acute perichondritis. (2) Submaxillary cellulitis or retropharyngeal abscess. (3) Scalds from inhaling steam. (4) Burns from swallowing corrosives. (5) Impacted foreign bodies. (6) General anasarca—*e.g.*, in chronic Bright's disease. (7) Angio-neurotic œdema. (8) Tuberculosis, syphilis or carcinoma of the larynx. (9) Radium or X-ray therapy.

The mucous membrane covering the epiglottis, aryepiglottic folds, false vocal cords and interarytenoid space is swollen and œdematous, with partial or complete obstruction to inspiration. Dyspnœa may be urgent and followed by asphyxia if unrelieved.

Treatment.—Steam inhalations of Friar's balsam, and ice compresses to the neck may relieve the condition, but in some cases, especially in children, laryngotomy or tracheotomy may be called for.

Syphilis.—Mucous patches may be seen in the secondary stage, but soon disappear under treatment. Diffuse gummatous ulceration or localized gumma of the epiglottis and aryepiglottic folds causes great

destruction and may lead to necrosis by extension to the cartilages. Hoarseness and dyspnoea are the symptoms, while subsequent cicatrization may lead to stenosis with obstruction. Antisyphilitic treatment should be instituted, and tracheotomy may be necessary for urgent dyspnoea.

Tuberculosis may be *intrinsic* or *extrinsic* and is nearly always secondary to phthisis, but occasionally to lupus of the nose or face. Submucous infiltration with ulceration are found in the inter-arytenoid fold. The central and posterior thirds of the vocal cords are usually first affected; later the epiglottis and aryepiglottic folds are swollen, œdematous, polypoid and pale. Hoarseness, cough, pain in swallowing and sometimes dyspnoea are the main symptoms.

Treatment.—Residence in a sanatorium is desirable, with absolute rest to the voice. Cauterization of ulcers and application of orthoform are sometimes of value.

Paralysis of the Larynx.—Results from paralysis of the recurrent laryngeal nerve, and may be:

1. *Unilateral and Incomplete.*—The abductor muscles on one side are paralyzed and the cord is adducted. The voice is unaltered, but dyspnoea may be noticed on exertion.

2. *Unilateral and Complete.*—The cord is immobile and lies midway between adduction and abduction (cadaveric position). The result is often slight, with transient weakness of the voice, the normal cord passing across the middle line in phonation.

3. *Bilateral and Incomplete.*—The abductors of both sides are paralyzed and dyspnoea so severe that tracheotomy is often needed. The voice may be unaffected.

4. *Bilateral and Complete.*—Both cords are in the cadaveric position and immobile. Absolute aphonia and slight dyspnoea result.

Causes.—(1) Injury—*e.g.*, gunshot wounds in the neck or operations on the thyroid gland. (2) Aortic aneurysm. (3) Disease of the mediastinal lymph glands—*e.g.*, tuberculosis, Hodgkin's disease or

- lympho-sarcoma. (4) Malignant disease of the œsophagus, thyroid gland, mediastinum or lung.
 (5) Pleural adhesions secondary to phthisis.

Neoplasms.

Papilloma.—The commonest innocent tumour affecting the larynx. The usual site is the under-surface of the true vocal cord in its anterior or middle part. Males are far more often affected, while the condition is not uncommon in children. Hoarseness and sometimes dyspnœa are produced. Removal of the tumour should be carried out by direct laryngoscopy.

Fibroma is not uncommon, and appears on the true or false cords near the anterior commissure, or on the epiglottis. It is usually single, small and pedunculated, but may be multiple and large with a broad base.

Chondroma, Angioma and Lipoma are all rare.

Carcinoma.—The chief incidence is between fifty and sixty years, males being far more often affected. It originates most frequently in the vocal cord as a squamous-celled growth, but basal-celled, papillary and adeno-carcinoma occur. Growths arising in the cords, ventricles of Morgagni or ventricular bands are termed *intrinsic* and include subglottic neoplasms; spread is usually slow until the extrinsic tissues are involved. *Extrinsic* growths are those commencing in other parts of the larynx—*i.e.*, epiglottis and aryepiglottic folds—and in these both local extension and infiltration of lymph glands rapidly occur.

Symptoms.—In the early stages these may be absent or indefinite, with the exception of hoarseness. In subglottic growths the symptoms suggest laryngitis. It cannot be too strongly emphasized that hoarseness persisting for several weeks in a patient over forty years of age must always be regarded with grave misgivings, and calls for expert laryngoscopy. In extrinsic growths the first sign may be a painless swelling in the lateral cervical region. Later, in both intrinsic and extrinsic types, dysphagia, blood-stained

expectoration, and neuralgic pain radiating to the ear may be present. The cervical glands are affected sooner or later, the resulting mass becoming adherent to the skin and deep structures; ulceration is followed by infection, and the patient dies of septic absorption, broncho-pneumonia, or secondary hæmorrhage.

Diagnosis.—Laryngoscopy in early cases will disclose a unilateral condition which must be distinguished from tuberculosis, syphilis, pachydermia, papilloma and paralysis. In doubtful cases biopsy should be performed.

Treatment.—(1) Laryngo-fissure is the operation of choice in cases restricted to one cord: the thyroid cartilage is divided in the middle line together with the cricothyroid and thyrohyoid membranes, permitting of easy access to the cord by retraction of the thyroid alæ. Diathermy excision of the growth and a surrounding margin of healthy tissue can then be performed. (2) Total laryngectomy is of value in more extensive growths confined to the larynx. Lateral pharyngotomy is used for post-cricoid growths and requires a plastic operation to close the stoma at a later date. (3) Radium therapy—interstitial after removal of part of the thyroid cartilage, or distance irradiation to include also the glandular areas. (4) X-ray therapy (high voltage).

The **Prognosis** of the intrinsic type is more favourable than in most other sites of the body, but once the extrinsic structures are infiltrated the outlook changes completely.

The Thorax.

Thoracic Injuries.—These are the result of violence applied to the chest wall, with or without fracture of ribs or sternum, and include penetrating wounds caused by sharp instruments, explosives, etc.

Fractures—1. **Ribs.**—Are usually broken by indirect violence, such as pressure on the chest with the back against some unyielding support. The ribs first bend and then break at their most convex part—*i.e.*, in front of the angle. Injury to the viscera is uncommon. When ribs are broken by direct violence,

the fragments may be driven inwards and puncture the pleura, lungs, liver, spleen, or diaphragm. The fifth to the eighth ribs are those most commonly broken.

Symptoms.—The patient feels a snap at the time of injury, and suffers from localized pain, which is increased during inspiration. If the back is fixed and the sternum pressed backwards, pain is felt at the site of fracture, and crepitus may or may not be elicited.

Treatment.—Strips of adhesive plaster reaching from spine to sternum should be placed over the injured side during deep expiration. The strips should overlap, and a bandage should be applied over them. If the fracture is due to direct violence, no strapping should be used, but the patient kept still by placing sand-bags on either side. Ribs always unite readily. Separation or fracture of a costal cartilage produces the same symptoms as a fractured rib.

2. *Sternum.*—Fracture is usually due to direct violence, but occasionally occurs in cases of fractured spine from indirect violence with the back bent. There may be displacement, which compresses the trachea and causes dyspnœa. Treatment consists of rest in bed, with a pillow between the shoulders. If there is displacement, it must be reduced by manipulation.

Non-Penetrating Wounds—(1) *Contusion of the Lung.*—If of the massive type, this is often quickly fatal. Ribs may or may not be fractured, according to their elasticity. In cases of moderate severity there is a rise of temperature, cough and blood-stained sputum. Infection may settle in the damaged lung tissue and a lung abscess follow.

In severe compression of the chest such as results from buffer accidents, explosions, etc., *traumatic asphyxia* may develop. It is characterized by intense cyanosis of the head and neck, protrusion of the eyes and subcutaneous hæmorrhages. Lung ruptures, hæmothorax and surgical emphysema often accompany this, but in the less severe cases recovery is to

be expected, and is complete in two or three weeks. Rupture of the diaphragm followed by hernia is not unusual, but often overlooked.

(2) *Laceration of the Lung*.—Usually follows fracture of the ribs, but in children the elasticity of the thoracic wall is so great that extensive intrathoracic lacerations may exist without any fracture. Severe shock, pain, dyspnoea, hæmoptysis or hæmothorax are the usual phenomena, but surgical emphysema or pneumothorax may coexist when the lung is torn.

Prognosis.—This depends on the depth of the laceration and the size of the vessels which are opened up, as well as on the rapidity with which blood or air accumulates in the pleural cavity, and whether or not suppuration supervenes. *Surgical emphysema* is recognized by the peculiar crackling sensation on palpation. It may be so extensive as to involve the body from scalp to foot, yet is seldom of any prognostic importance and may disappear rapidly.

Penetrating Wounds.—If the wound is large the primary danger is 'open pneumothorax,' which is often rapidly fatal. The dominating factor is infection, especially when associated with the presence of foreign bodies such as shell fragments, clothing, etc. Gas-forming organisms are the most serious, since they tend to spread rapidly; the commoner pyogenic organisms tend to produce localized lesions. There is often injury to intercostal arteries and sometimes to the heart or great vessels; infection tends to be followed by secondary hæmorrhage. If blood accumulates in the pericardial sac 'heart tamponade' follows, the heart sounds are obscured, arterial pressure falls and venous pressure rises, leading eventually to cerebral anoxæmia. When blood accumulates in the pleural cavity there is always the danger of late infection. In stabs and gunshot wounds the diaphragm and upper abdominal viscera are frequently damaged. The three main complications are:

1. *Pneumothorax*.—This may be closed, open or valvular. The first is rarely serious, the second is fraught with grave danger from the tendency to mediastinal flutter, while the last threatens the func-

tion of the undamaged lung, which becomes more and more hampered as the mediastinum is displaced (ingravescent pneumothorax). Skiagraphy is of prime importance diagnostically, and treatment demands continuous aspiration of the affected pleural cavity.

2. *Hæmothorax*.—This is not often rapidly fatal, and depends for its extent on the size and site of the vessel injured. Apical wounds bleed more than do those at the base of the lung. Bleeding usually ceases before the lung is completely collapsed. The blood remains unclotted for ten days or more unless infection supervenes. Diagnosis is made by aspiration and by skiagraphy. If virulent infection of the effusion occurs, grave toxæmia develops, with dyspnœa, pyrexia, jaundice, and later delirium.

3. *Pulmonary Collapse*.—This is present to some degree on the side of the injury in all cases, and may also supervene on the non-penetrated side.

Treatment of Thoracic Injuries.—1. *Non-penetrating*.—Warmth, strapping of the injured side and morphine usually suffice for the less serious injuries, but venesection is desirable for cases associated with embarrassment of the right heart, or open operation if there is clear evidence of bleeding from a lacerated lung or intercostal vessel.

2. *Penetrating*.—Unless the result of stabs with clean instruments or of high velocity bullets or small shell fragments, these usually require operative treatment if seen soon after the occurrence. Badly shocked cases need blood and plasma transfusion and a temporary occlusive dressing must be applied. Skiagrams are essential if foreign bodies are likely to be present. The operation should be conducted under intratracheal anæsthesia with provision for forcible inflation of the lungs, as well as some method of aspiration of blood and secretion, with a wide exposure to allow of proper examination and access to bleeding vessels. All badly damaged superficial tissues should be excised, and foreign bodies removed. Bleeding points must be ligated, and it is essential to excise damaged pulmonary tissues and to suture the resulting gap, otherwise infection will spread from

lung to pleura. The latter should be closed and drainage avoided. If there are small wounds of entry and exit, and indications of only a moderate collection of blood or air in the pleura, no immediate operation is called for, but chemotherapy is advisable to ward off infection. Hæmothorax is best treated by aspiration within about three days with oxygen replacement. If infection occurs, aspiration should be repeated until localization is complete, when the freest possible drainage should be afforded.

Abdominal injuries may coexist and need enlargement of the diaphragmatic wound, to afford access to foreign bodies or permit suture of solid or hollow viscera. The gap in the diaphragm should invariably be sutured.

Empyema (*Purulent Pleurisy*).—Usually follows pneumonia, and is commonly due to pneumococci or streptococci; less often staphylococci, gas-forming organisms and the *Bacterium coli* are concerned, and in chronic cases the tubercle bacillus or *Streptothrix actinomyces*. In its acute form empyema is commoner in children.

Empyema usually occurs as a complication of lobar or broncho-pneumonia, abscess of the lung or bronchiectasis; it is rarely hæmatogenous.

Signs and Symptoms.—These are what would be expected from a collection of fluid in the pleural cavity. The onset may be ushered in by one or more rigors, with increase in dyspnœa and toxæmia. There is defective movement of the chest on the affected side, the percussion note is impaired, breath sounds are absent, and vocal resonance and fremitus diminished. Skiagraphy reveals that the lung is compressed and the mediastinum displaced. Lymph is deposited on both visceral and parietal pleuræ, and may organize before obliteration of the cavity is complete, the walls becoming rigid and unyielding. The space so left tends to persist unless compensated for by (1) mediastinal displacement, (2) collapse of chest wall and scoliosis, (3) rise of diaphragm, (4) exuberant granulations.

Should a sinus persist after drainage, and if irriga-

tion fails to reduce the amount of discharge, operative measures similar to those necessary for chronic empyema are called for. If neglected, an empyema may present superficially (empyema necessitatis), having burst through one of the intercostal spaces (usually the fifth), but few such cases survive long, even if the abscess eventually ruptures.

Diagnosis.—The aspirating needle is essential for early diagnosis, and even when it fails to tap a definite collection of pus, examination of the lumen of the needle may provide valuable evidence pointing to infection. Frequently pus is revealed in quantity: if (a) thin and serous it is probably streptococcal; (b) thick with masses of lymph, pneumococcal; (c) foul-smelling, the *Bacterium coli* is probably responsible.

Prognosis.—The streptococcal form is more serious than the pneumococcal, and in general, empyema is a more dangerous disease in children than in adults. Should empyema develop during a frank pneumonia it is a graver matter than when there is a distinct interval between the two. The more rapid the localization of the collection of pus, the less interference with the action of the lung and the less likelihood of generalized infection; pneumococcal cases tend to conform to the former type, streptococcal to the latter.

Treatment.—Sulphonamide therapy may abort or help to localize an empyema when the lung infection is pneumococcal or streptococcal, but must be instituted at once and in full doses.

1. **Aspiration.**—This is the proper method in the treatment of streptococcal empyema in its earlier stages, and whenever empyema co-exists with, rather than succeeds, pneumonia. It should be repeated until the creamy consistence of the fluid withdrawn indicates that drainage is desirable. Aspiration is also to be employed when the empyema is bilateral, the two sides being treated on alternate days. Whenever there is evidence of respiratory distress during aspiration, oxygen replacement should be combined with it, as by this means the whole instead of a part of the fluid can be safely withdrawn. When the

aspirated fluid is thin and foul, an effort should be made to prevent gangrenous cellulitis of the chest wall by an incision down to the ribs, packing off this incision after each aspiration, followed by intercostal drainage as a purely temporary measure.

2. *Drainage*.—This should always be by the closed method, which aims at continuous suction by means of a siphon or Sprengel's pump. The pressure maintained is only slightly less than that of the atmosphere, but the lung is thereby helped to expand. The ideal site for drainage is the lowest part of the empyema cavity, which usually corresponds with the paravertebral gutter as far back as possible. A metal trocar and cannula may be introduced through an intercostal space, but this provides less effective drainage than thoracotomy through a suitable space or after rib resection. One to one and a half inches of the posterior part of the seventh, eighth or ninth rib should be removed through a vertical incision with due regard to the exact site of the pus, local anæsthesia being desirable in most cases. The pleura is incised, the finger introduced, pus allowed to escape slowly, all masses of fibrin evacuated, septa broken down, and the wound closed tightly around a flanged tube. In massive empyema measures must be taken to provide slow decompression. Irrigation of the empyema cavity is advantageous in the absence of a bronchial fistula.

Open drainage is to be recommended only in emergency, in the absence of a suitable suction apparatus.

Breathing exercises with Wolff's bottles form an essential part of the after-treatment; they should be continued for ten to fifteen minutes, three or more times daily. Inhalation of CO₂ often enhances the effect of the foregoing.

Complications include pericarditis, peritonitis, pointing (empyema necessitatis), bronchial fistula and meningitis.

Chronic Empyema.—A chronic empyema is one of more than three months' duration; the cavity contains thick pus and has indurated walls. It is often

associated with clubbing of the fingers, emaciation and in young people scoliosis and cyanosis. Usually the condition has been completely latent, but some arise from loculation or imperfect drainage of an acute empyema or when there is an associated bronchial fistula. The lung is partially collapsed, often fibrosed, and the pleura greatly thickened. Radiology, if necessary, after the injection of an opaque fluid through the sinus will solve most of the diagnostic problems.

Treatment.—(a) Remove foreign bodies—*e.g.*, empyema drainage tube; (b) provide proper drainage and institute continuous irrigation, and renew respiratory exercises; (c) freely incise fibrous tissue over the lung; or (d) adopt measures permitting the chest wall to collapse. Tuberculous empyema (*q v.*) is not amenable to this type of treatment. Free removal of portions of ribs over the cavity, combined with irrigation, will often suffice in the less serious cases. If the cavity exceeds 100 c.c., decortication of the lung is often needed, but must usually be combined with a local thoracoplasty, so that both the parietal and visceral walls are simultaneously mobilized. Formal thoracoplasty of an extensive type, such as Schede's or Estlander's, is sometimes necessary, and if done in stages the eventual results are good.

Tuberculous Empyema.—When a pleural effusion in a case of pulmonary tuberculosis has a high cellular content it is termed an empyema, but acid-fast bacilli are only to be found after careful search. Secondary infection by staphylococci is to be feared and studiously avoided.

Treatment.—Drainage must on no account be employed unless gross secondary infection is present. Aspiration is therefore to be relied upon, repeated as may be necessary, but avoiding the same sites owing to the added danger of secondary infection. Lavage is helpful in the absence of a pleuro-bronchial fistula; the injected fluid should be warmed and of moderate volume. Normal saline is probably as good as solutions of the various aniline dyes. Thoracoplasty must be adopted when the above means fail, especially

if fistulæ have formed. An operation in two or more stages is usually desirable, as a far greater degree of collapse of the chest wall is necessary than for pulmonary tuberculosis proper. When secondary infection has ensued, intercostal drainage followed by thoracoplasty is indicated.

Bronchiectasis.—This term is employed for any pathological dilatation of the air tubes, with or without suppuration. Any condition which causes weakening of the bronchial walls or imposes an excessive pressure on them during coughing may produce bronchiectasis. The condition is often congenital and then may be non-progressive. The acquired form often starts in childhood and is insidious in progress, but may be acute—*e.g.*, after aspiration of foreign bodies. Cylindrical, sclerosing and saccular forms are described. The lesion is usually unilateral: pleural adhesions are common. As in other chronic suppurative intrathoracic diseases, there is a danger of cerebral abscess.

Paroxysmal cough and foetid sputum characterize the condition, but hæmoptysis is not unusual, as well as pyrexial attacks. Skiagrams after lipiodol injections will reveal the distribution of the disease, but all the lobes of both lungs must be investigated.

Treatment is directed to emptying, followed by obturation, of the dilated tubes. The former requires postural treatment combined, it may be, with aspiration through a bronchoscope. The latter is best achieved by artificial pneumothorax together with phrenic evulsion, but when a large cavity exists drainage may be required. In well-localized unilateral cases partial or complete lobectomy or pneumonectomy in one or more stages is to be recommended, and even in bilateral cases radical extirpation may succeed.

Lung Abscess.—Unlike bronchiectasis, this starts in the lung parenchyma and affects the bronchi secondarily. If the condition spreads, it may rupture into a bronchus or into the pleura.

Many arise from (1) carcinoma of the lung; (2) extension from suppuration in the abdomen or medi-

astinum; (3) embolism in association with remote infections; (4) aspiration of infective material in connexion with operations on the upper air passages; (5) specific infections; (6) rarely from lobar or broncho-pneumonia.

The organisms are those common in pyogenic infection, but anaerobes are prominent as well as certain spirilla which usually inhabit the mouth. The sputum usually contains elastic fibres

The base of the lung, especially the right, is the commonest site affected, and bronchiectasis often complicates the picture. The symptoms are those of severe toxæmia, in particular rapid loss of weight and marked secondary anæmia, associated with a swinging temperature.

The physical signs depend on the size of the abscess, the degree of pulmonary consolidation, and the presence of direct communication with the air passages, but cough and foetid sputum are usually prominent symptoms. Clubbing of the fingers appears at an early stage. Skiagrams reveal a defined cavity and a fluid level, while lipiodol injection will prove whether there is a connexion with the air passages. Aspiration is inadvisable owing to the risk of infecting the pleural cavity. Most cases burst into a bronchus, and if the cavity is not too large, particularly in children, it may heal without any serious sequelæ. In cases which do not heal rapidly, especially those at the base, there is always the fear of cerebral abscess as the result of septic emboli from the pulmonary vein reaching the left heart and, via the carotids, the brain.

Treatment.—It is unwise to operate before complete localization of the abscess has occurred, and in the meantime anæmia and infection must be combated by intravenous injections of arsenic (N.A.B.) and by subcutaneous antigasgangrene serum. If the abscess bursts into a bronchus, postural drainage will be necessary during the healing process. Surgical treatment should not be postponed later than eight weeks, as by that time complete localization has occurred. The methods available are:

1. *Phrenic evulsion* and *thoracoplasty* are rarely advisable.

2. *Thoracotomy*, with open drainage, is usually the best course. The rib resection should be adequate, and if the visceral pleura is not already adherent to the chest wall the operation must be done in two stages, a gauze pack soaked in tincture of iodine being inserted after opening the chest so as to produce adhesions. The cautery is the best means of incising the lung tissue to reach the abscess cavity.

3. *Plombierung* is a method of avoiding a two-stage operation when the pleural layers are still ununited. After the rib resection the parietal pleura is stripped off and paraffin plugging inserted, so that pressure is exercised on the lung, especially over the abscess cavity.

4. *Lobectomy* may be necessary, especially when bronchiectasis co-exists.

Actinomycosis of the lung is usually primary. It produces a multilocular granulomatous mass in the pulmonary tissues, spreading to the pleura and the chest wall, in which numerous sinuses develop. The pus may contain characteristic 'sulphur granules,' but more often the streptothrix is discovered by microscopical examination. The disease is resistant to treatment, though massive doses of iodides are sometimes effective.

Pulmonary Tuberculosis.—Surgery is of value in supplementing general hygienic measures for the treatment of this disease, particularly in the form of 'collapse therapy,' whereby rest is provided to the part of the lung in which the disease is most active. It is suitable for cases wherein the disease is mainly unilateral. The effects of artificial pneumothorax are (a) to produce immobilization; (b) to cause collapse of cavities and thus reduce cough, sputum and fever; and (c) to arrest hæmorrhage.

The methods of producing collapse are:

1. Artificial pneumothorax, which has the advantages of revocability and adjustability, but cannot be employed if adhesions exist which are not divisible. Once committed to this form of treatment it must be

persisted in, and refills are necessary at comparatively short intervals for three or four years. Effusions tend to follow repeated refills, and some become purulent; they may need aspiration, lavage of the pleural cavity, and gas replacement.

2. Phrenic evulsion is particularly helpful in producing a certain degree of permanent collapse, and is especially useful towards the end of the phase of treatment by artificial pneumothorax.

3. Thoracoplasty is of value when A.P. has failed owing to the presence of adhesions. The collapse produced is permanent. The operation, which may be partial or complete, should as a rule be carried out in stages. It is often desirable to combine methods 2 and 3.

4. Extrapleural pneumothorax. The adherent pleural layers are separated from the overlying ribs and intercostal muscles and an air space kept up by repeated injections.

Intrathoracic Tumours.—Reference has already been made to one type—viz., intrathoracic goitre. Mediastinal dermoids are usually clearly demonstrable by skiagraphy, and are best treated in stages by marsupialization, though some are amenable to complete excision at one operation. Ganglio-neuroma, neurofibroma, thymoma and lympho-sarcoma may also be met with in the thorax.

Innocent tumours of the bronchi include adenoma, papilloma and fibroma. The first is commonest and gives rise to hæmoptysis and later bronchial obstruction. Benign tumours of the lung are surgical rarities. Primary carcinoma appears to be increasing in frequency, especially in men, and can sometimes be related to specific irritants—*e.g.*, radio-active dust (Schneeberg mines). It arises from the basement cells of the bronchial epithelium and is characteristically polymorphic in type, squamous and 'oat' cells being found in one part and adeno-carcinoma elsewhere. It begins in or near a main bronchus, later producing obstruction, bronchiectasis or necrotic lung abscess. Mediastinal or supraclavicular glands are soon involved and cerebral deposits relatively

common. Pyrexia, dyspnœa and weakness form a suspicious triad of symptoms, but skiagraphy, preferably after A.P. and combined with lipiodol, will usually permit of a diagnosis, especially if tubercle bacilli are absent from the sputum. Bronchoscopy and thoracoscopy may be needed for confirmatory purposes. A limited number can be excised by lobectomy, but in most cases recourse to radiotherapy is alone available, the results being often encouraging for a time, but the eventual outlook is gloomy.

Injuries of the Heart may be rapidly fatal from primary hæmorrhage, from pressure on the roots of the great vessels following bleeding into the pericardial sac (heart tamponade), or from injuries to the coronary artery, not forgetting associated lesions of the lung and pleura. In exceptionally favourable cases the heart may be sutured after exposure through a long intercostal incision or by splitting the sternum. The pericardial sac must be drained.

Suppurative Pericarditis is amenable to surgical drainage. Aspiration is required to confirm the diagnosis. A needle of moderate bore is inserted below the costal margin just to the left of the middle line, the patient's back being arched over a pillow. If pus is withdrawn, drainage is best secured by removal of portions of the fifth and sixth ribs and rib cartilages. Several small flexible rubber tubes should be inserted.

Adherent Pericardium may be due to intra- or extra-pericardial adhesions, and if extensive is sometimes benefited by the removal of ribs over the adherent area, dividing adhesions and excising thickened pericardium from over the heart itself.

Pulmonary Embolectomy is occasionally carried out in cases of sudden lodgment of a large clot in the pulmonary artery. Death normally follows in a few minutes, but in exceptionally fortunate cases, by rapid exposure and incision of the pulmonary artery after resecting ribs and costal cartilages, the clot has been removed and the pulmonary artery successfully sutured. In favourable cases this and other forms of post-operative arterial and venous thrombosis

and embolism may be prevented by continuous intravenous 'heparin' infusion.

Coronary Thrombosis.—Attempts have been made to treat this by providing an accessory blood supply from the omentum which is stitched to the heart. The indications are obscure and the results dubious.

The Thymus may be the seat of hyperplastic changes, accompanied by splenic enlargement and widespread lymphatic overgrowth throughout the body. This combination constitutes *status lymphaticus*, and is often recorded as the lethal factor in sudden deaths during operations under anæsthesia or after injuries not of themselves likely to prove fatal. There is grave doubt as to the justification for such a conclusion. The thymus is often enlarged in Graves' disease, but never when the latter arises in a patient in whom the gland is already atrophic, hence the conclusion that the thymus is only of secondary importance in this association.

CHAPTER XXXII

INFECTIONS OF THE HAND

THE vital importance of the functions of the hand in nearly all walks of life and the disastrous consequences which may result from apparently trivial injuries should need no emphasis. An exact knowledge of the surgical anatomy of the hand, especially of the tendon sheaths, fascial spaces and lymphatics is requisite for diagnosis and treatment. Every grade of infection ranging from a septic blister to a rapidly fatal septicæmia may follow a scratch, puncture or crush. In many of these the more serious sequelæ can be avoided by such preventive measures as:

1. Immediate immobilization of the hand and arm in a sling.
2. Measures to further *free bleeding* from punctured wounds, etc.
3. Cleansing of the hand and dressing of the wound.

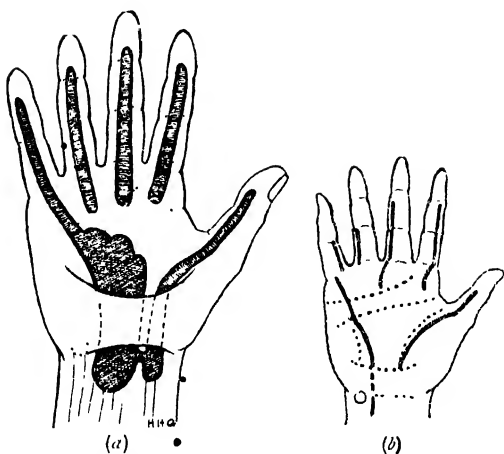


FIG. 37.—(a) FLEXOR TENDON SHEATHS OF THE HAND AND (b) INCISIONS FOR DRAINAGE.

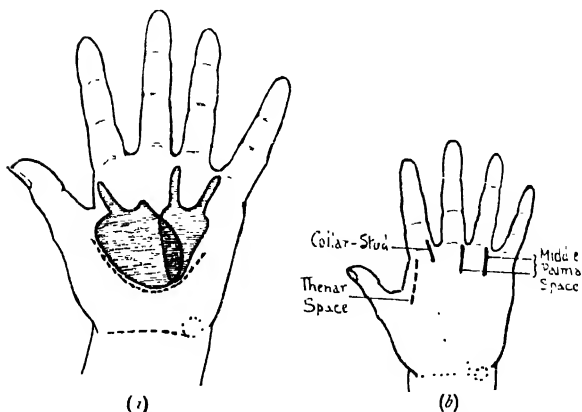


FIG. 38.—(a) FASCIAL SPACES OF THE HAND AND (b) INCISIONS FOR DRAINAGE.

4. Exhibition of sulphonamide whenever there is reason to fear or suspect a streptococcal infection.

Classification.—(1) Pulp infections, (2) paronychia, (3) acute suppurative tenosynovitis, (4) palmar abscess, (5) lymphangitis. (Some of these lesions were formerly described under the term *whitlow*, now obsolete.)

1. **Pulp infections** involve the fatty subcutaneous tissue of the distal phalangeal region and follow pricks by thorns, needles, splinters, sharp spicules of bone during surgical operations, etc.; occasionally no wound is discoverable. The organism is usually a staphylococcus, and the infection usually remains locked up for a time in the compartments which comprise the pulp structure. Tension rapidly increases, and unless pus is evacuated at an early stage, necrosis of bone and spread to tendon sheath, etc., may follow.

Signs and Symptoms—Pain is at first slight, but soon becomes severe and throbbing; there is swelling and acute tenderness followed by induration and later fluctuation. The proximal part of the finger and dorsum of hand then swell, but are not tender to touch. Pyrexia is moderate and constitutional symptoms slight. Differentiation from acute lymphangitis is made by noting that in the latter the tenderness is not localized to the pulp, red streaks are visible in the forearm, and there is no induration of the pulp.

Treatment should be by lateral incisions to open all compartments of the pulp.

2. **Paronychia** is also staphylococcal in origin, the site of entrance being usually a hang-nail. The cuticle becomes reddened, tender and swollen on one side of the nail; later this spreads to the whole basal collar. Pus forms between the nail-root and nail-bed, not superficial to the former.

Treatment.—In early stages a portion of the nail-root is removed to drain the underlying pus; in later stages the whole nail-root must be sacrificed, the remainder of the nail being left *in situ*, and drainage

effected by a rubber strip. Chronic paronychia is due to neglect of the acute variety.

3. **Acute Suppurative Tenosynovitis.**—This results from (a) injuries which open up the tendon sheath, (b) spread from infections of the pulp, or (c) lymphangitis. Pus forms, and unless tension is released early it spreads into the fascial spaces and the tendon sloughs. The infection is usually streptococcal, and great care must be exercised to prevent secondary staphylococcal involvement from without during dressing of the wound and similar exposures.

Signs and Symptoms—(1) Throbbing pain; (2) swelling which involves the whole finger; (3) acute tenderness over the infected sheath; (4) severe pain on attempting to extend the affected digit, which remains partly flexed at all joints.

Later there is swelling on the dorsum of the hand at the base of the other fingers, and sometimes of the forearm as well. The general condition soon worsens and any attempt to straighten the flexed finger causes agony. In the case of the little finger or thumb spread occurs into the ulnar or the radial bursa respectively, and acute tenderness can be elicited at these sites. The whole hand becomes very swollen, particularly on the dorsum. Pyrexia, sometimes with rigors and malaise, characterizes this stage.

Treatment.—In the index, middle and ring fingers, lateral incisions over the middle or proximal phalanx afford access to the pus without risk of prolapse of the tendons. The joint region should be left intact, but drainage must be extended to the proximal extremity of the sheath in most cases. In the *little finger* the proximal incision must be carried upwards boldly as far as the anterior annular ligament. In the *thumb* the sheath of the long flexor must be drained freely, with the proviso already noted, through a skin incision which follows the line of the short flexor muscle, but ends at a point 1 inch above the anterior annular ligament.

4. **Palmar Abscess.**—A collar-stud abscess is one which forms under the calloused pads at the bases of

the fingers and, unable to reach the surface, tracks between the palmar fascia to the webs of the fingers; one part of the abscess cavity lies under the skin, the other on the deep aspect of the palmar fascia. If neglected, this may spread to tendon sheaths and fascial spaces.

Signs and Symptoms.—A tender swelling forms which corresponds to the callous area, and is also visible on the dorsal aspect of the web.

Treatment.—A vertical incision on the palmar surface should be followed up by a counter-incision to drain the posterior pocket.

5. Fascial Space Abscess —Middle and thenar fascial spaces are infected secondarily from elsewhere in the hand. The middle space is particularly related to the little, ring and middle fingers and the ulnar bursa, though both it and the thenar space are vulnerable to lymphatic spread and to direct puncture. The thenar space is specially related to the index finger and thumb and to the radial bursa.

Signs and Symptoms — The presence of the primary infection of the hand which precedes fascial space involvement tends to obscure the localizing features peculiar to the condition. The concavity of the palm is replaced by a slight but highly tense convexity. In thenar space infections there is definite local ballooning. Tenderness, which may be diffuse over the whole hand, is greater over the affected space.

Treatment — (a) *Middle Palmar Space* —An incision is made from the web of the little or ring fingers as far as the middle flexion crease of the palm, beyond which it is dangerous to go for fear of damaging the superficial palmar arch. The lumbrical muscle is the best guide to the flexor tendons, deep to which the pus is found. The space should be drained by a thin rubber slip.

(b) The *thenar space* should be opened from the dorsum along the radial border of the second metacarpal, and the pus reached in front of the adductor transversus by working below its distal edge.

6. Acute Lymphangitis.—This is nearly always a

streptococcal infection which follows a minute prick in the terminal segment of a finger. The organisms reach the lymphatics directly and spread along them as far as the epitrochlear or axillary lymph nodes. Later spread occurs beyond the lymphatic tissues and the whole hand becomes swollen, dusky red and brawny, blisters appear, and the infection reaches the forearm and arm in the graver cases. Large bullæ may appear and pus forms in the tendon sheaths, fascial spaces, etc. There is severe constitutional disturbance, and in the worst cases death from septicaemia may result in a day or two. In the less severe cases the whole condition may resolve without pus formation within forty-eight hours. It is of the greatest importance to distinguish between acute lymphangitis and pulp infection; in the former the tenderness and swelling of the pulp is never severe, and the high temperature and red streaks of lymphangitis are not seen in simple pulp infection.

Treatment.—Confinement to bed, passive hyperæmia with a Bier's bandage applied for from three to six hours initially, then reapplied for similar periods after an hour's respite. Never incise at this stage, as there is no pus to evacuate and infection is likely to be spread thereby. Large moist poultices renewed frequently may be helpful. Free diuresis and purgation are calculated to help in eliminating the toxins. Specific antitoxic sera in doses of 20 c.c. should be given immediately, but are often bitterly disappointing. Sulphanilamide or sulphapyridine intravenously, intramuscularly or intraorally (or combined) should be given in full doses (see p 15), and small blood transfusions are often of real value.

General Principles in Treatment.—1. Be certain that pus is present and of its exact site before making an incision.

2. Always operate under general anæsthesia and employ an air-compression tourniquet.

3. Rubber tissue is preferable to any form of tube drainage.

4. Avoid the use of extremely hot fomentations

or baths. Change to infra-red or short-wave therapy after a few days.

5. Preserve or restore full function by encouraging the patient to persevere with active movement from the start.

CHAPTER XXXIII

AFFECTIONS OF THE BREAST

Malformations.

Amastia.—Absence of one or both breasts is a rare condition found usually in males and sometimes associated with absence of the sternal portion of the pectoralis major.

Gynæcomastia is an abnormality of the male breast, which enlarges and resembles the virgin female organ in size; in most cases the overgrowth is confined to the connective tissue framework, and not infrequently the sexual organs are ill-developed.

Polymastia, or the presence of supernumerary breasts, is by no means uncommon in both sexes. The accessory organs are usually to be found along a line running from the axilla to the symphysis pubis, and are rudimentary and functionless, but occasionally the seat of carcinoma.

Diffuse Hypertrophy.—This usually affects both breasts, the enlargement being due mainly to overgrowth of glandular tissue. In many instances the condition commences either at puberty or during pregnancy and progresses until the breasts sag to the thighs. Endocrine dysfunction is assumed to be responsible, and the frequent association with irregularity of the periods supports this view. Discomfort and unsightliness often call for partial or complete amputation of the breast.

Injuries often result in large hæmatomata owing to the laxity and vascularity of the breast tissues. Suppuration not infrequently follows, while in some cases a blood cyst is left.

The Nipple.

Fissure is rare apart from lactation, and results either from failure to dry the nipple after suckling, from eczema of the areola, or from trauma during the act of feeding. The condition is extremely painful, so that nursing is often discontinued and the breast becomes engorged. Infection with pyogenic organisms is thereby favoured, leading to acute mastitis from spread along the milk ducts or lymphatics, or in some cases to axillary lymphadenitis.

Treatment—Prophylaxis.—During the last few weeks of pregnancy the nipples should be cleansed daily with boracic lotion and hardened with alcohol; after nursing they should be carefully dried. When once a fissure has formed, nursing on that side should be discontinued temporarily, the milk being withdrawn with a breast pump. The fissure may be painted with Friar's balsam or dressed with lotio plumbi, and if healing is slow the application of caustics such as silver nitrate may be helpful.

Eczema is not uncommon, and is usually found in association with fissure of the nipple.

Discharge from the nipple, if clear, is due to chronic mastitis. If milky, it may indicate a galactocoele. If bloody, it indicates a duct papilloma or carcinoma.

Abscess of areola, chancre of the nipple and sebaceous cysts are occasionally seen.

The Breast.

Acute Mastitis.—Inflammation of the breast occurs in the following forms:

1. *Mastitis Neonatorum.*—In newly born children the breasts may become swollen and tender, with slight discharge from the nipple. No treatment is needed as the condition usually subsides, but occasionally suppuration calls for incision.

2. *Mastitis of Puberty.*—May arise in children of both sexes, the whole or part of one breast becoming

indurated and tender; after some weeks the condition subsides without treatment

3. *Metastatic Mastitis*.—In acute specific fevers, particularly mumps, one or both breasts may become inflamed and tender; resolution is the rule, but suppuration may occur

4. *Infective Mastitis*.—This is associated in practically all cases with a fissure of the nipple during lactation, and is preceded by milk engorgement, which paves the way for infection to spread along the ducts or lymphatics. The causal organism is in most instances *Staphylococcus aureus*, in a few *Streptococcus pyogenes*. Apart from lactation, infection of a hæmatoma following an injury may cause mastitis, which is also met with in pyæmia. Suppuration is a frequent sequela, a mammary abscess developing.

Signs and Symptoms.—The whole breast or one segment of it becomes swollen, indurated and tender, the overlying skin reddened, and the axillary glands enlarged and tender. The temperature is raised, with well-marked constitutional disturbance, and locally there is severe throbbing pain. With the onset of suppuration the skin becomes more discoloured, œdema can be recognized, and fluctuation may be detected over a localized area.

Treatment.—Suckling must be discontinued, the breast kept emptied by a breast pump, and a Klapp's suction bell applied for an hour twice a day. The breast should be supported by a bandage and the arm kept at rest. Saline purges, potassium iodide and belladonna internally are sometimes recommended, but chemotherapy is more likely to be effective.

Mammary Abscess.—Three distinct types are recognized:

1. *Supramammary (Subareolar)*.—The pus is superficial to the breast tissue, and the usual cause is an infected sebaceous gland or cyst. The abscess is small and soon points on the surface, general disturbance being slight.

2. *Intramammary*.—The most common type resulting from infective mastitis. In many cases the pus tends to burrow widely in the substance of the breast,

producing an extensive loculated cavity. Toxic absorption is severe, with irregular pyrexia and rigors.

3. *Submammary (Retromammary)*.—The abscess lies between the breast and the underlying muscles. The usual causes are (a) infection of a hæmatoma following injury; (b) an empyema which has tracked through the chest wall; (c) tuberculous disease of ribs or spine, when the abscess is of the 'cold' variety; (d) cellulitis of the chest wall, often the result of an ill-administered subcutaneous infusion. Acute mastitis of lactation is an unusual cause. Diagnosis may be difficult until the abscess points at the outer side of the breast, when fluctuation can be detected.

Treatment.—(1) The supramammary type needs a small incision followed by hot fomentations. (2) Intramammary abscess should be drained freely by incisions radiating from the nipple, fibrous septa broken down by the finger, and counter-incisions provided at the dependent parts of the breast; drainage tubes are essential for the first few days. Sinuses may persist for months in spite of all efforts to provide free drainage, and partial or complete amputation of the breast may ultimately be called for. (3) The submammary type needs 'closed' drainage at the lower and outer side of the breast except in the tuberculous variety, for which special treatment should be instituted (see p. 11).

Chronic Mastitis.—A non-inflammatory disease of unknown etiology occurring in several different forms. While local infection can be excluded, endocrine dysfunction may be a factor, and the involutionary changes which the breast undergoes would appear to play an important part. It frequently develops near the menopause, but also in unmarried women at an earlier age, while males are not exempt; there is sometimes a history of trauma, and the disease is said to be more common after abortion.

Pathology.—The characteristic feature is an excess of fibrous tissue; the ducts are blocked by epithelial debris, retention of secretion resulting in cysts, which may be single or multiple and vary in size. In the

opinion of some, chronic mastitis is a pre-cancerous condition, but satisfactory clinical and pathological proof is still wanting and the possibility of mere coincidence cannot be denied.

Signs and Symptoms.—The disease is found at all ages—in the married and unmarried, multiparæ and nulliparæ—and produces neuralgic pain and tenderness, especially at the periods. Examination may reveal (1) both breasts knotty with multiple small swellings (chronic interstitial mastitis); (2) a localized wedge-shaped area which is indurated, tender and nodular (chronic lobar mastitis); or (3) a single large cyst near the nipple, forming a hard, tense, tender swelling in which fluctuation may be detected. A serous or dark green discharge is not uncommon. The axillary glands are often palpable and tender.

Diagnosis.—No difficulty will be experienced when both breasts are diffusely affected. Localized areas of mastitis may be confused with fibro-adenoma or carcinoma; in a mastitic cyst the swelling tends to be more spherical, is tender, may be elastic at the centre and translucent on transillumination.

Treatment.—In any case of doubt, especially in women over forty years, the breast should be explored and examined immediately by frozen sections, or later by formal methods. Once the diagnosis has been established, the part should be supported and kept free from pressure of corsets. Local applications of ung. hydrarg. or belladonna plasters, potassium iodide and ovarian extract by mouth are sometimes recommended. If the condition is progressive and associated with considerable pain, sub-areolar mamnectomy is desirable.

Chronic Abscess.—May occur during pregnancy, follow infection of a hæmatoma or a pre-existing retention cyst, or supervene on an attack of mastitis. A localized indurated swelling appears; it is painful and tender and slowly increases in size. Fluctuation is often difficult to elicit owing to the thickened abscess wall. There may be a purulent discharge from the retracted nipple, and the axillary glands are sometimes enlarged and tender.

Treatment.—When possible, complete excision of the affected area is preferable to drainage and curettage of the abscess wall.

Tuberculosis is rare, the result of blood-stream infection. The breast becomes swollen, indurated and nodular, foci of softening and suppuration following; eventually the overlying skin is invaded, becoming reddened, while multiple sinuses appear discharging typical pus. The axillary glands are enlarged and eventually matted. The condition occurs in women between twenty and forty years who are frequently the victims of phthisis.

Treatment.—General treatment for tuberculosis should be instituted. Amputation of the breast and overlying skin with excision of the axillary glands is advisable if the patient's condition warrants it.

Cysts of the Breast.—These may arise from the ducts or alveoli (acinous), or from the interstitial connective tissue (interacinous).

I. Acinous Cysts—**1. Retention.**—Obstruction of a duct causes retention of secretion. The following types occur:

(a) Galactocoele, which appears during or after lactation and contains inspissated milk. It forms a solitary rounded smooth swelling near the areola; the nipple is often retracted. Tenderness is absent, fluctuation may often be elicited, and milk can be expressed from the nipple. Excision may be necessary if the swelling persists when lactation has ceased.

(b) In association with neoplasms—*e.g.*, duct papilloma or duct carcinoma—which may press on one of the main ducts.

2. Involution.—Multiple small cysts containing thick greenish-yellow or dark brown material are often present in chronic mastitis, especially when the disease affects menopausal women.

II. Interacinous Cysts—**1. Serous (Lymphatic).**—Are multilocular, lined by endothelium, and contain clear fluid which may be blood-stained or shimmering with cholesterin. The thickness of the wall, which is composed of fibrous tissue, is a prominent feature. The swelling is painless, fluctuation may be detected,

and the overlying skin is stretched and thin. There is no discharge from the nipple

2. *Sebaceous*—Are practically confined to the areola.

3. *Blood*.—Follow injury with resultant hæmatoma.

4. *Degeneration*.—Are not uncommon in carcinoma, sarcoma, or soft fibro-adenoma.

5. *Hydatid* (see p. 80).

6. *Dermoid* (see p. 79).

Neoplasms.—Innocent and malignant varieties are both of frequent occurrence.

I. **Innocent**—1 **Fibro-adenoma**.—Two types are recognized:

(a) *Hard fibro-adenoma*, characterized by excess of fibrous tissue containing thin, narrow clefts lined by epithelium. The tumour is well encapsuled, on section greyish or pinkish white, and has a whorled or plicated appearance: It is most common in unmarried women under the age of thirty, and frequently situated near the periphery of the breast. It forms a smooth, painless, rounded or oval swelling, with marked mobility and no adhesion to skin or underlying structures. There is no retraction of the nipple or enlargement of the axillary glands.

(b) *Soft fibro-adenoma* contains less fibrous tissue, the epithelial spaces being more prominent. It occurs at a later age, is of more rapid growth, and forms a soft, elastic, freely mobile tumour which may reach the size of a small melon, the skin becoming thinned out, bluish and translucent. Cystic degeneration or sarcomatous change may supervene in the stroma.

Diagnosis.—Rests mainly between fibro-adenoma and chronic mastitis. The distinctive features of a fibro-adenoma are its free mobility, the sharp definition and the absence of tenderness. If the tumour is surrounded by an area of chronic mastitis, diagnosis may be well-nigh impossible without biopsy.

Treatment.—Excision may be readily performed through an incision radiating from the nipple, or by Gaillard-Thomas's operation; a curved incision along the outer and lower border of the breast enables the organ to be turned upwards and inwards, the tumour being approached from the deep surface.

2. **Cystadenoma** (*Cystic Sarcoma, Intracanalicular Adenoma*).—An unusual tumour, rapid in growth but definitely encapsulated. On section, multiple cystic spaces are seen more or less filled with papillary growths; microscopically the epithelium is columnar. It is found, usually in women over forty, as a soft irregular mass with fluctuant areas; frequently it is of large size. The overlying skin becomes thin and bluish and may eventually give way, allowing the tumour to protrude and fungate.

Treatment.—Amputation of the breast is usually necessary owing to the difficulties of enucleation.

3. **Duct Papilloma**.—A small, soft, vascular and warty tumour which grows from the wall of one of the main ducts; it may be single or multiple. Obstruction to the lumen of the duct may lead to the formation of a retention cyst in the region of the growth. Blood-stained discharge from the nipple is frequently the only symptom, while on examination no abnormality may be detected, or merely a small elastic swelling felt close to the nipple. In many cases localization of the tumour can only be achieved by noting the discharge produced when the affected duct is pressed upon.

Treatment.—Partial or complete amputation of the breast is indicated, owing to the danger of malignant transformation.

II. **Malignant**—1. **Sarcoma**.—Accounts for 2 per cent. of all breast tumours, and is usually found under the age of forty-five. In many cases there is a history of a blow. Two types are recognized:

(a) Round-celled, which is highly malignant and prone to cystic degeneration, hæmorrhages into the tumour and myxomatous changes. Metastases in glands and viscera are an early feature.

(b) Spindle-celled is less malignant and of slow growth, partaking of the characters of a fibrosarcoma; it tends to be hard, metastases are uncommon, though local recurrence after removal is frequent.

2. **Carcinoma**.—The breast is the commonest site in the body for malignant disease, excepting only

the stomach. Most cases occur around middle age, about 1 per cent. of them affecting the male. The upper and outer quadrant is most frequently involved, next in order being the lower and outer, upper and inner, and finally lower and inner. There is an equal incidence in multiparæ and nulliparæ, though suckling appears to confer relative immunity.

Pathology.—The majority of cases appear to arise in the glandular acini and terminal ducts, and partake of the characters of spheroidal-celled carcinoma (p. 72). In a few the epithelium is of columnar form, sometimes arranged in a tubular manner, this type being nearly always found in relation to one of the large ducts (duct carcinoma). Colloid types occur occasionally. A rare variety appears to arise in the epithelium of sweat glands.

Extension of the disease takes place by (1) direct spread through the tissues; (2) growth of cells along the lymphatic vessels and plexuses, the majority of which lie in the fascial planes (lymphatic permeation); (3) emboli in both lymph and blood streams. Metastases appear in the regional lymph glands, the bones, especially the spine and upper end of femur, and later in the viscera.

The skin overlying the breast may be infiltrated and ulcerated. By extension of growth inwards the breast becomes adherent to the underlying fascia, muscles, and chest wall. Nodules of growth may appear both in and under the skin, and sooner or later the regional lymph glands become infiltrated, enlarged, hard and matted.

Lymphatic Extension (see Fig. 39).—This occurs mainly through the medium of two lymph plexuses, one lying in the subcutaneous fatty tissue, the other on the pectoral fascia. From these plexuses lymph is carried by various paths—viz.:

1. To the axillary glands, subdivided into four main groups: (a) Central, lying along the axillary vessels; (b) pectoral, deep to the pectoral muscles; (c) subscapular, on the posterior axillary wall; and (d) subclavicular, at the apex of the axilla.
2. To the anterior mediastinal glands lying along

the course of the internal mammary artery *via* the inner ends of the intercostal spaces.

3. To the epigastric region and peritoneal cavity.

4. To the opposite breast by a few lymph vessels which cross in front of the sternum.

5. To the supraclavicular glands by vessels which pass directly over the clavicle

Bloodvessel Extension.—It appears probable that metastasis to vertebrae, ribs and skull occur *via* the

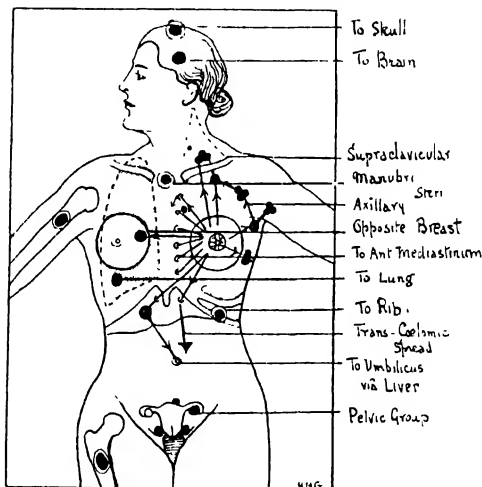


FIG. 39.—THE SPREAD OF CARCINOMA OF THE BREAST.

venous system rather than by arterial or lymphatic channels.

Signs and Symptoms.—The most frequent age is between thirty-five and sixty, and the commonest site the upper and outer quadrant. The following signs appear:

1. Localized mass of stony hardness with an irregular nodular surface, invading the breast tissue. It is often noticed accidentally.

2. Adhesion to the skin leads to dimpling, puckering, nipple retraction and elevation of the breast.

3. The whole organ may be infiltrated and shrunken.

4. Later the breast becomes adherent to the pectoral fascia and muscle, and eventually to the chest wall.

5. The axillary glands are at first enlarged and stony hard, later becoming matted; the supra-clavicular glands undergo similar changes.

6. When the primary growth lies to the medial side of the nipple, a secondary deposit sometimes appears early in the opposite breast.

7. Paralysis of the arm, severe pain radiating to the fingers, or solid œdema of the hand and arm may result from pressure of enlarged axillary glands.

8. Dimpling and puckering of the skin overlying the breast may be followed by induration, discoloration and ulceration; the edges of the ulcer are hard and raised, the crater filled with fungating growth. Solid lymphatic œdema of the skin from blockage of lymph vessels produces *peau d'orange*, the skin becoming thickened with coarse punctate depressions corresponding to the openings of the sebaceous glands. Diffuse infiltration of the skin, sometimes seen in the more rapidly growing types—e.g., encephaloid carcinoma—leads to *cancer en cuirasse*. Multiple small cutaneous nodules are formed, with induration and reddish discoloration in the neighbourhood.

9. Metastases in the liver produce jaundice, in the lung dyspnoea and pleural effusion, in the peritoneum ascites, and in the bones severe and constant pain, the ribs, sternum, upper end of femur or humerus and the dorso-lumbar spine are the parts usually affected. Diffuse carcinomatous changes in the skeleton, with decalcification, softening, and bending of bones, may occur (carcinomatous osteomalacia).

10. Cachexia with sallow complexion and emaciation.

Death usually occurs within two to three years of the onset.

Varieties.—1. *Scirrhus* is the common type, growth being comparatively slow. On section of the tumour

the surface is concave, greyish-white with yellowish areas and sometimes small hæmorrhages. It grates on the knife like an unripe pear.

2. *Encephaloid* (medullary) is more uncommon, of rapid growth and bad prognosis, ulceration and metastases occurring early; it usually affects younger patients. When cut across it is of greyish-pink colour, soft and homogeneous, with cystic and hæmorrhagic areas.

3. *Atrophic scirrhus* is usually found in thin elderly patients. Excess of fibrous tissue results in shrinkage of the breast and adhesion to the skin; the tumour itself remains small and causes no inconvenience for many years.

4. *Colloid* is rare and of slow growth, the prognosis being good.

5. *Lactation carcinoma* is of such rapid growth that the condition may be mistaken for a mammary abscess. The breast becomes swollen, the skin overlying it discoloured and œdematous with dilated veins; to the touch it feels hot and the temperature is often raised. Absence of pain, rigors or malaise, and lack of tenderness in the axillary glands, although matted, serve to distinguish it from mammary abscess.

6. *Duct carcinoma*, a growth closely related to duct papilloma, presents on section warty nodules growing into the lumen of one of the larger ducts and also infiltrating surrounding tissues. Usually of relatively low malignancy and rather slow growth, it often appears close to the nipple as a small swelling, which may be cystic. Adhesion to the skin may be followed by discoloration and ulceration. Blood-stained discharge from the nipple is almost invariably present, and can be expressed by pressure over the tumour. Occasionally duct carcinoma takes on extremely malignant characters and disseminates widely through the blood stream while the primary growth is yet trivial in size.

7. *Paget's Disease (Dermatitis Maligna)*.—Eczema of the areola and nipple is present, followed in every case by cancer in the underlying breast. Whether the growth in the breast or the eczema is the primary

condition is a matter of controversy, while by some the carcinoma is thought to arise in the deeper layers of the dermis. Collections of large multinucleated transparent cells (Paget cells) are sometimes found. The disease occurs in women between the ages of forty and sixty years, and the eczema may be present for more than a year before any tumour is palpable in the breast. Redness of the nipple and areola, scales and excoriated areas are found in the early stages, while later the nipple disappears and a bright red weeping surface with copious discharge and crusts is seen.

Treatment.—Radical removal of the breast, axillary contents and pectoral muscles *en bloc* should be performed.

Diagnosis.—It is only in the early, yet most important, stage that difficulties are encountered. The following points are in favour of carcinoma: (1) The tumour is hard, nodular, and its limits ill-defined. (2) It is incorporated in the breast tissue and cannot be moved independently of the breast, unlike fibro-adenoma. (3) The skin over the tumour may be dimpled or the nipple retracted. (4) Fixation to the underlying pectoral fascia may be present. (5) There is no translucent area on transillumination, such as may be seen in tense mammary cysts. (6) Blood-stained discharge from the nipple must always be regarded with grave suspicion.

If the smallest doubt exists as to the nature of a breast tumour, especially after the age of thirty, exploration is called for. To the naked eye on section carcinoma appears as a concave, greyish-white tumour in which are small yellow areas; its surface is gritty and juice may be scraped from it. Fibro-adenoma on section is pinkish-grey, homogeneous, convex, and sometimes whorled, with smooth narrow clefts scattered throughout; in chronic mastitis white fibrous tissue is a prominent feature, with cysts containing greenish, yellowish, or brownish fluid.

Treatment.—1. Radical excision of the affected breast, together with (a) the overlying skin for a

radius of at least 3 inches round the tumour, (b) as wide an area of deep fascia as possible, (c) both pectoral muscles, and (d) the lymph glands, fatty and areolar tissue of the axilla *en bloc*, is the method of choice in all early cases.

Contra-indications.—(1) General conditions precluding a major operation—*e.g.*, myocarditis, chronic bronchitis. (2) Metastases in lungs, liver, long bones, spine or other parts. (3) Fixation of the breast to the chest wall. (4) Matted axillary or enlarged supraclavicular glands. (5) Cancer *en cuirasse*.

2. *Irradiation.*—Many cases unsuitable for radical operation have derived considerable benefit from radium, used interstitially or at a distance (teletherapy), and it is true that cure has followed these methods. Only too frequently, however, the primary growth appears to have been completely destroyed, yet glandular and visceral metastases develop in the course of succeeding years. X-ray therapy is of definite value in many cases, growth being arrested temporarily both in the breast and glandular metastases, while the pain due to secondary deposits in bone is relieved. Both X-rays and radium are frequently employed after radical operation, with the object of preventing recurrences (prophylactic irradiation), and there is considerable evidence to prove that this object may be attained.

3. *Palliative.*—Incurable cases can often be made more comfortable and the disease arrested temporarily by such measures as local amputation of the breast where ulceration and fungation are present, or by irradiation in one form or another. When anæmia and cachexia are prominent features, blood transfusion, ultra-violet light therapy, and nourishing diet are useful adjuncts.

Prognosis.—When the breast alone is involved the outlook is favourable, 90 per cent. of cases being alive and well five years after radical operation. When the axillary glands are involved the number alive and well after the same period is about 30 per cent. The average period from the time the con-

dition is first noticed until medical aid is sought is a year, during which many cases progress to the stage of axillary infiltration.

CHAPTER XXXIV

AFFECTIONS OF THE ABDOMEN AND PERITONEUM

Abdominal Injuries.

I. **Abdominal Wall.**—(a) Wounds may be non-penetrating or penetrating, immediate laparotomy is called for in the latter to ascertain the extent of and treat any injuries to underlying viscera. (b) Contusions are frequently associated with severe visceral injury, even though apparently slight. Partial or complete rupture of muscles or aponeuroses is usually accompanied by a hæmatoma, which may be subcutaneous, intramuscular, or extraperitoneal.

II. **Intra-Abdominal**—I. **Solid Viscera.**—Injuries to these result in internal hæmorrhage, the signs of which may be divided into general and local.

General.—Increasing pulse rate, pallor, restlessness, sighing respirations, cold clammy skin, dimness of vision and noises in the ears are the chief indications. Sometimes there is a latent period of a day or two before sudden onset of graver signs.

Local.—These vary, depending upon whether the hæmorrhage is intra- or extra-peritoneal.

(a) *Intraperitoneal.*—Movement of the abdominal wall on respiration is restricted, generalized tenderness may be elicited on deep pressure, and localized rigidity detected over the injured viscus. The front of the abdomen is usually resonant, but dulness, varying in extent when the patient is moved on to the side (shifting dulness), may be present in the flanks. Diminution or absence of peristalsis may be revealed by auscultation. Shoulder-tip pain is sometimes present.

(b) *Extraperitoneal*.—This is usually due to injury to the kidney, and manifests itself by an indefinite swelling in the flank which tends to increase slowly and to spread towards the iliac fossa.

2. **Hollow Viscera**.—In the majority of cases abdominal pain and nausea or bilious vomiting develop immediately after the injury, but later tend to subside for some hours. There may be an initial period of some hours with minimal symptoms. The pulse then rises and becomes weaker, the skin is cold and clammy, the face pinched and grey. Pain is first of a colicky type, but soon becomes constant.

On abdominal examination signs of bruising or grazing may be observed and movement is restricted, especially in the injured area. Rigidity spreads and there is deep local tenderness. Hyper-resonance due to gaseous distension of the bowel is usual, and diminution of liver dulness is a frequent sign. It must not be assumed that this latter invariably implies free gas in the peritoneal cavity, as it may be due to a distended colon overlapping the liver; when, however, resonance is found over the liver area in the flank, this may be taken as certain proof of the presence of free gas. On auscultation, the absence of peristalsis in the injured area is an important point. Free gas may be detected early by X-ray examination.

Many cases are complicated by injury to solid viscera, fracture of the ribs or pelvis and damage to the thoracic contents, and in consequence the symptoms of shock or hæmorrhage are more pronounced and the diagnosis rendered more difficult. In all cases of doubt, careful observation for three to four hours is necessary before deciding to resort to laparotomy, and this time should be spent in combating shock by warmth and fluids, studiously avoiding morphine and other sedatives.

In 90 per cent. of cases the small bowel is affected; usually the duodeno-jejunal region when the patient has been run over, the terminal ileum in more localized injuries. Rupture may be complete or incomplete, and in 10 per cent. of cases is multiple. At operation systematic examination of the whole

intestinal tract and its mesenteries, together with the rest of the abdominal organs, is essential.

In penetrating wounds there may be discharge of blood or of the contents of hollow viscera, or prolapse of omentum or bowel. Hæmatemesis or rectal bleeding is also significant. X-ray evidence of foreign bodies or of intraperitoneal gas may be obtainable. Success in treating injuries to hollow viscera depends essentially on the earliest possible intervention.

Diseases of the Abdominal Wall.

Congenital Defects.—1. Congenital umbilical hernia. A large sac of peritoneum containing abdominal viscera protrudes into the thinned-out umbilical cord.

2. Absence of the lower part of the abdominal wall, in conjunction with the anterior wall of the bladder and symphysis pubis, is found in *ectopia vesicæ*.

3. Umbilical faecal fistula is due to non-closure of the vitello-intestinal duct.

4. Umbilical polyp. This appears as a polypoid protuberance resembling a ripe raspberry, and represents an evagination of a persistent portion of the vitello-intestinal duct. The proximal part of the duct may persist in the form of a Meckel's diverticulum or as an intraperitoneal cyst.

5. Umbilical urinary fistula or sinus is due to non-closure of the urachus. The connexion with the bladder is so attenuated that leakage of urine is unusual.

6. Urachal cyst, due to distension of a persistent portion of the urachus, may bulge through the umbilicus or lie deep to the lower abdominal wall in or near the middle line.

7. Accessory nipples are occasionally found as raised pigmented areas along a line from axilla to groin.

Recurrent Fibroid of Paget (Desmoid Tumour).—An unusual fibro-sarcoma arising as a rule from the rectus sheath in the form of a hard localized mass,

which infiltrates the abdominal wall and shows a marked tendency to local recurrence after removal. Irradiation by radium or X-rays often arrests the disease for considerable periods.

The Peritoneum.

Peritonitis.—Inflammation of the peritoneum is due to infection (*a*) from without—*e.g.*, penetrating wounds; (*b*) from the gastro-intestinal tract after injuries, perforations, inflammatory processes or mechanical obstructions; (*c*) from the female genital organs—*e.g.*, gonorrhœa; or (*d*) from the blood stream—*e.g.*, septicæmia.

Peritonitis may be divided clinically into acute and chronic varieties, each of which may be localized or spreading.

Acute Spreading Peritonitis—Causes.—1. In the majority of cases it is due to spread of inflammation from some focus in the gastro-intestinal tract or its adnexa, the infection being a mixed one. *Bact. coli* and staphylococci predominate, but streptococci, *Ps. pyocyanea* and *B. proteus*, as well as *Cl. Welchii* and other anaerobes, may be present, especially when paralytic distension and stagnation supervene. Common causes are acute appendicitis, perforated gastric or duodenal ulcers, and diverticulitis.

2. Conditions interfering with the blood supply of the bowel—*e.g.*, strangulated hernia, volvulus, and intussusception.

3. Spread from the female genital organs, usually resulting from gonorrhœa or puerperal infection.

4. Rare causes are septicæmia, streptococcal or pneumococcal, irritant fluids such as pancreatic juice, bile or urine, and penetrating wounds.

Symptoms.—(1) Abdominal pain, usually the first indication, is constant, dull and aching; it may either be localized to some particular area or at first referred to the umbilicus, later becoming diffuse. (2) Vomiting of stomach contents usually follows, later becoming bilious, and finally brownish and offensive; unlike the vomiting of intestinal obstruction, it is without

nausea and non-projectile. (3) Constipation for both faeces and flatus is almost invariably present. (4) Hiccough is a late and persistent symptom of grave import

Signs.—(1) *Facies*: In the early stages the expression is anxious and the eyes lack lustre; later the eyes become sunken and the face drawn, with a greyish pallor and a cyanotic tinge to the lips (*facies Hippocratica*). (2) *Posture*: The patient lies on his back; the knees are flexed to relax the abdominal muscles and to prevent pressure of the bedclothes on the tender abdomen. (3) The breath has an unpleasant, almost pathognomonic, odour. (4) The tongue is thickly furred and later brown and dry. (5) The temperature is raised to a moderate extent (100° to 102°), but tends to become subnormal as the toxæmia increases. (6) The pulse rises steadily as the infection spreads, being at first small and hard, later weak and of low tension. (7) The respirations are rapid, shallow, and thoracic in type. (8) The abdomen is full, rigid, and tender, in parts tympanitic, in others dull; on auscultation peristaltic sounds are absent.

Diagnosis.—The association of abdominal pain, localized or referred to the umbilicus, with tenderness and rigidity of any part of the abdomen, calls for constant observation with an accurate record of the pulse rate at frequent intervals. On no account should morphine or other sedatives be given. A steady rise in the pulse, spread of abdominal tenderness or the onset of vomiting indicate the need for immediate surgical intervention. In many cases the appearance of the patient and the unpleasant odour of the breath afford strong confirmatory diagnostic evidence.

Differential Diagnosis.—(1) In the early stages of pleurisy and pneumonia pain may be referred to the abdomen, the abdominal wall being rigid and the signs of intrathoracic disease trivial. The respirations are more rapid, the pulse full and bounding, the face flushed and the *alæ nasi* working (especially in children), and although hyperæsthesia of the ab-

domen may be present, tenderness on deep pressure is absent. On auscultation peristaltic sounds are heard. (2) Intestinal obstruction is distinguished by the colicky nature of the pain, increased peristaltic sounds on auscultation, and more forceful vomiting. (3) Colic, whether renal, biliary or intestinal, is intermittent and accompanied by sweating, the pain usually radiating characteristically. (In plumbism a blue line on the gums and punctate basophilia are present.) (4) Influenza, malaria, and other general infections may commence with symptoms simulating peritonitis, but careful observation for a few hours usually suffices to clear up any doubts. (5) Intra-peritoneal hemorrhage is accompanied by more acute pain, extreme abdominal tenderness and the signs of internal bleeding. (6) Uræmia is revealed by the changes in the urine; the patient, whose breath may be characteristic, is often drowsy. (7) *Tuberculosis* may be a cause of severe abdominal pain and vomiting, but the pupils are pin-point and the knee-jerks lost. (8) Spinal caries in the dorso-lumbar region will usually be detected by careful examination and by skiagrams.

Treatment.—(1) Immediate operation directed to the cause, followed by drainage whenever the peritoneal cavity contains sero-purulent or purulent fluid; a rubber tube should be left in the pouch of Douglas, supplemented by others in the flanks when the peritonitis is generalized. Excess of free fluid should be evacuated with a mechanical aspirator or by gentle mopping with sterile gauze. Many prefer to drain only in special cases. (2) Fowler position: The patient is nursed sitting upright with a back rest and foot support. (3) Sedatives: Morphine $\frac{1}{8}$ to $\frac{1}{4}$ gram or heroin $\frac{1}{12}$ to $\frac{1}{8}$ gram is usually needed for the relief of pain during the first forty-eight hours, but such drugs should be discontinued as soon as possible, as they tend to aggravate any tendency to paralytic ileus. (4) Fluids with added glucose—*e.g.*, fruit drinks, China tea—should be given liberally by mouth, supplemented by glucose (5 per cent) in normal saline administered per

rectum by the continuous drip method. In cases with severe toxæmia the glucose-saline solution should be given for several days by the intravenous route at the rate of 1 pint every three to four hours. (5) Turpentine enemata are of great value in relieving that most troublesome symptom, flatulent distension; they may be repeated four-hourly if necessary, and are often more effective if pituitrin (1 c.c.) is injected intramuscularly ten minutes before the enema. (6) Pituitrin or pitressin 1 c.c., escrine sulphate $\frac{1}{10}$ grain may be injected six-hourly up to four doses, or acetyl choline 0.1 gramme hourly for six doses, when paralytic ileus is threatened or present. (7) Bile enemata, using human or ox bile (2 ounces) or the patient's vomit in quantities of 4 to 8 ounces, will sometimes assist the bowel to regain its tone and relieve the frequent vomiting. (8) Chemotherapy by sulphonamides, etc., may be of value when the nature of the infecting organisms is known or the character of the pus indicates this course. Anti-gas-gangrene serum, formerly advocated, has been found wanting in efficacy. (9) Flatus tube: this should be left in the rectum. (10) Gastric lavage is of use when regurgitant vomiting occurs; a Rehfuss tube left *in situ* facilitates this. (11) Spinal anaesthesia, by abolishing sympathetic inhibition, will often initiate bowel action in the early stages of ileus. (12) Jejunostomy is of doubtful value, but in desperate cases is advocated by some as a means of draining the paralyzed bowel and thereby relieving toxæmia, but the Miller-Abbott tube may prove more effective without recourse to operation.

Acute Localized Peritonitis.—The causes are similar to those of spreading peritonitis, the essential difference being that the infection becomes shut off from the general peritoneal cavity within a short space of time—usually about forty-eight hours. This localization is effected by deposition of fibrin and the adhesion of adjacent coils of intestine and other viscera, the greater omentum often playing a part. Suppuration is frequent, resulting in intraperitoneal abscesses (*vide infra*).

Signs and Symptoms.—Localized abdominal pain and tenderness are always present, and may be associated with vomiting, constipation, and pyrexia. The affected area does not move on respiration, and is resistant or rigid on palpation. Later a localized mass, dull or tympanitic on percussion, can sometimes be felt, and auscultation reveals loss of peristaltic sounds. Fluctuation, redness and œdema of the skin, or œdema and induration of the mucous membrane of vagina or rectum, indicate that the abscess is pointing in one or other of these situations.

Repeated leucocyte counts are of value in confirming the onset of suppuration.

Treatment.—The majority of cases should be kept under careful observation for signs of suppuration or extension of the disease, when operation should be performed. Immediate operation is called for in some instances—*e g.*, appendicitis—as the risks of delay are greater than those of operation. Drainage of the affected area may often be combined with removal of the cause.

Pelvic Abscess.—Common causes are salpingitis, appendicitis, and sepsis following abortion or labour. A tender mass forms which may be palpable abdominally and can also be felt bimanually. The mucous membrane of rectum or vagina may be thickened, œdematous, and feel hot and dry. Rectal tenesmus or the passage of mucus, vaginal discharge, difficulty and frequency of micturition with pyuria, may be associated with constipation, pyrexia, and a brown furred tongue. The abscess may burst into the rectum, vagina, bladder or peritoneal cavity.

Treatment.—Hot vaginal douches or rectal lavage may need to be followed by drainage of the abscess through rectum, vagina or abdominal wall.

Subphrenic Abscess (see Fig. 40).—This is a collection of pus beneath the diaphragm. Most cases are secondary to perforated gastric or duodenal ulcer or appendicitis. Uncommon causes are cholecystitis, inflammatory diseases of the liver or spleen, hepatic abscess, empyema, or suppuration spreading from the colon, kidney or spine.

The right side is more frequently affected, and the abscess may be above the liver to one side or other of the falciform ligament, or below (subhepatic) in the greater or lesser sac of the peritoneum; another variety is extraperitoneal. In 15 per cent of cases gas is present in the abscess cavity.

Signs and Symptoms.—In the majority the onset is insidious, pain being slight or absent. The patient develops a hectic temperature together with other signs of toxic absorption, while cough and slight

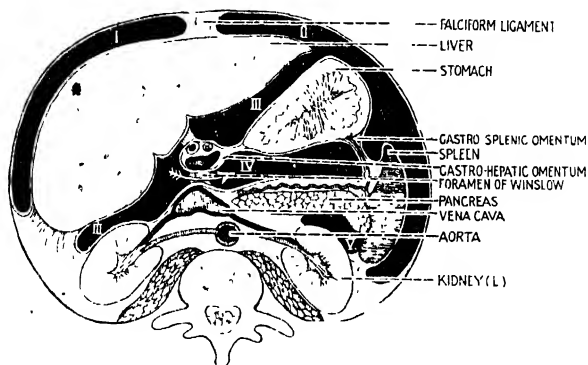


FIG. 40 - SURGICAL ANATOMY OF SUBPHRENIC ABSCESS

I, Right anterior; II., left anterior; III, subhepatic; IV, in lesser sac; V, retroperitoneal

expectoration may also be present. There may be tenderness over the lower ribs and intercostal spaces, limitation of movement on respiration and diminished breath sounds, with crepitations and prolonged expiration. The liver dulness is sometimes increased, but may be obliterated or diminished when the abscess contains gas. Epigastric fulness may occur.

Skiagrams show the diaphragm to be immobile, excessively domed and displaced upwards; a fluid level and air-bubble may be revealed; the heart may be

displaced upwards especially with an abscess on the left side, but never laterally as in empyema.

Treatment.—To establish the diagnosis, aspiration of the pleural cavity and subphrenic region is sometimes required, and should be followed by immediate operation, if pus is found. Resection of part of the ninth or tenth rib in the mid-axillary line will usually enable the diaphragm to be incised without opening the pleural cavity, which is already shut off by adhesions. If, however, the pleural cavity is not so obliterated at this point, the diaphragm should be carefully sewn to the parietal pleura before it is incised. In a limited number of cases effective drainage of a subphrenic or subhepatic abscess can be carried out through a subcostal incision. In retroperitoneal varieties drainage is often possible extrapleurally and extraperitoneally by resecting the twelfth rib posteriorly.

Pneumococcal Peritonitis.—This may be primary, or secondary to pneumonia, empyema, pharyngitis or otitis media. The primary form is practically confined to female children of four to fourteen years, and is more common in the summer months; the organisms (pneumococci) gain entrance through the genital tract, and can be isolated in most cases from the vaginal secretion. The onset is usually sudden, with abdominal pain, pyrexia, vomiting, and not infrequently diarrhoea; the child may be drowsy or delirious, and meningitis simulated.

The abdomen is full and tender, but rigidity is absent or slight. Within a few days localization of the exudate may result in a subphrenic or pelvic abscess. The pus is greenish-yellow, with a slightly sweet odour, and contains thick flakes of fibrin.

Treatment.—Opinions differ as to the wisdom of operating in early cases; most surgeons prefer to nurse the patient in the Fowler position on restricted diet with ample fluids, supplemented by antipneumococcal serum (see p. 13) and blood transfusion. Localized abscesses need free drainage. Early administration of sulphonamides in full doses may prove decisive.

Gonococcal Peritonitis.—A disease practically con-

finer to women, infection spreading upwards from the vagina via the uterus and Fallopian tubes. It may be diffuse, or localized to the pelvis (pelvic peritonitis). The onset is acute, with abdominal pain, vomiting, and pyrexia; the abdomen is distended, tender, and rigid, and there is generalized tenderness on pelvic examination; vaginal discharge is usual, in which gonococci can often be demonstrated. In the course of a few days the signs tend to abate. The peritonitis subsides, leaving adhesions with matting of the pelvic organs, the Fallopian tubes being usually sealed off and sometimes distended with pus (pyosalpinx). The patient complains of backache and lower abdominal pain, and the general health suffers. Vaginal discharge persists, and pelvic examination usually discloses an indurated mass in the pouch of Douglas or in the lateral fornix.

Treatment.—In the acute stage the patient should be nursed in the Fowler position, kept on a light diet, and the bowels regulated; hot vaginal douches and fomentations to the abdomen help to relieve pain. Chemotherapy must not be neglected. Should the patient's condition deteriorate, drainage of the peritoneum is called for. In the later stages the opening of localized abscesses and removal of the Fallopian tubes is often necessary.

Tuberculous Peritonitis.—In the main this is a disease of children and young adults, in whom it is secondary to a focus in some other part, usually the intestines, mesenteric glands, testicle or Fallopian tube. It is sometimes localized, but more frequently diffuse.

Varieties.—1. *Ascitic.*—The most common type, in which the peritoneum is thickened and studded with tubercles. There is a large amount of effusion, usually straw-coloured and clear but occasionally blood-stained.

2. *Fibrous.*—Dense adhesions produce matting of the intestines, shrinkage of the mesentery and contraction of the omentum, which may be palpable as a transversely elongated mass above the umbilicus.

3. *Suppurative or Ulcerative.*—Large caseous masses

may liquefy to form abscesses, which on bursting lead to fistulous openings between coils of intestine (fistula bimucosa) or open on the skin, usually at the umbilicus.

4. *Encysted*.—The disease is confined to one area, usually the pelvis in women, a localized mass developing which may be mistaken for an ovarian cyst.

It must be remembered that combinations of the above varieties are often found, and that at any stage secondary infection with organisms from the bowel may lead to acute peritonitis.

Signs and Symptoms.—These vary widely. The onset may be acute with abdominal pain, distension and a slightly raised temperature; rigidity and abdominal tenderness may be found in conjunction with signs of free fluid in the peritoneal cavity. In other cases the onset is insidious, sometimes with weakness and loss of weight, slight abdominal discomfort, diarrhoea alternating with constipation, or progressive enlargement of the abdomen; the temperature may be raised and of a hectic type.

The most pronounced feature of the ascitic variety is the gradual distension of the abdomen until the skin becomes tense and shiny with prominent dilated veins. The fibrous variety is usually associated with wasting, abdominal pain and constipation, and it is not unusual for intestinal obstruction to supervene; the abdomen is 'doughy' to palpation, with here and there hard irregular masses and scattered dull areas on percussion.

Treatment.—All cases should be kept in bed under the best possible hygienic conditions, fresh air, good food and sunlight or ultra-violet light being indispensable. Laparotomy is of great value in the ascitic variety, the fluid being removed and the abdomen closed; 75 per cent. of cases do well after this procedure. Operation is contra-indicated in the fibrous and suppurative varieties, owing to the serious risk of producing a faecal fistula, and also to the fact that as a rule little or no benefit ensues. Removal of the primary focus—*i e.*, Fallopian tubes—is often called for in the encysted variety, and good results follow.

Ascites.—An accumulation of serous fluid in the peritoneal cavity

Causes.—(a) Cardiac disease, (b) renal disease; (c) portal obstruction; (d) tuberculous peritonitis; (e) carcinoma of the peritoneum; (f) rupture or obstruction of the receptaculum chyli, in this the fluid is milky in appearance from its high fatty content (chylous ascites).

Signs.—The abdomen is distended and resonant in front, but dull in the flanks and sometimes above the pubes, the dullness varies with the position of the patient (movable dullness), and a fluid thrill can be obtained from one side of the abdomen to the other, while a hand is held firmly in the mid-line

Treatment.—(1) Tapping with trocar and cannula often affords temporary relief. (2) The Talma-Morison operation of omentopexy is sometimes of value in ascites due to cirrhosis of the liver.

The Mesentery.

Injuries.—These may lead to intraperitoneal hæmorrhage or thrombosis of the mesenteric vessels and be followed by gangrene of the bowel with peritonitis.

Mesenteric Thrombosis.—This is seen in volvulus and strangulation of the bowel, but also independently of these; intestinal obstruction (*q v.*) and gangrene of the intestine result, with the passage of blood-stained motions.

Tuberculous Mesenteric Glands (*tabes mesenterica*).—These are found in children, giving rise to abdominal pain, diarrhœa or constipation, wasting and irregular fever. General treatment for tuberculosis is necessary. Calcification is frequent, and later in life the shadows seen in skiagrams may be confused with those due to calculi in the urinary or biliary tracts; the symptoms are often similar, especially in those cases where pressure or traction on the ureter is caused by cicatrization in the neighbourhood of the glands.

Mesenteric Cysts.—Occur in the form of rounded tense swellings behind or below the umbilicus, mov-

able from side to side, and usually mistaken for ovarian or pancreatic cysts. They may be (1) lymphatic cysts, single or multiple, and contain clear fluid or chyle; (2) blood cysts which follow injury, degeneration of an angioma or hæmorrhage into other tumours; (3) teratomata or dermoids; and (4) hydatids. Characteristically they are mobile in a direction at right angles to the attachment of the mesentery.

CHAPTER XXXV

HERNIA

Definition.—The protrusion of a viscus or portion of a viscus through an opening or weak spot in the walls of the cavity in which it is contained. In this chapter the term is restricted to the abdominal contents. The common situations are the inguinal canal, crural canal, umbilicus and the sites of previous incisions; less often the diaphragm, obturator foramen and the sciatic notch.

Etiology.—*Congenital Causes*—(1) Patency of the funicular process (or the canal of Nuck in the female) is responsible for most cases of oblique inguinal hernia, though the swelling may not appear until after puberty. (2) Imperfect or late descent of the testis is often associated with an inguinal hernia, which may be interstitial. (3) Inherited weakness of the abdominal muscles and undue patency of the inguinal rings tend to run in certain families. (4) Congenital defects in the umbilicus, linea alba, linea semilunaris opposite the tendinous intersections of the rectus, and in the diaphragm. (5) Abnormal length of the mesentery or omentum and visceroptosis may play a part when other defects are present.

Acquired Causes.—(1) Weakness of the abdominal wall may be due to (a) stretching of operation scars, especially after suppuration; (b) trauma; (c) pregnancy; (d) old age; and (e) debilitating diseases. (2) Repeated strain resulting from (a) occupation; (b) chronic bronchitis; (c) chronic constipation; and

(d) difficult micturition from urethral stricture or enlarged prostate. (3) Increased abdominal pressure such as occurs in obesity, abdominal tumours, etc.

Structure.—A hernia consists of a peritoneal sac, its contents and coverings.

The *sac* is at first thin and funnel-shaped, but later becomes thickened and sometimes sacculated or hour-glass in shape. The *neck* is the portion adjoining the parietal peritoneum and may be wide or narrow and thickened; the *fundus* or body is the distal part, and is usually expanded. Repeated injury or the pressure of a truss often sets up a localized peritonitis in the sac, adhesions forming between its walls and between the sac and contents. By this means the peritoneal cavity may become shut off from the sac and a natural cure of the hernia results; more frequently the distal part of the sac becomes filled with a serous effusion, producing a **hydrocele of a hernial sac**.

The *coverings* consist of the layers of the abdominal wall and vary according to the site of the hernia. In time they become indurated and matted, particularly at the neck of the sac, and often play an important part in strangulation.

The *contents* may be any abdominal viscus, with the possible exception of the pancreas, but usually only small intestine or omentum is found.

Special mention must be made of the following types:

1. Enterocoele: contains bowel, usually small intestine, which may contract adhesions to the sac and become irreducible, obstructed or strangulated.

2. Epiplocele: contains omentum which is usually indurated and irreducible, either from adhesion to the sac or excessive bulk. Apertures may form in the omentum and are liable to cause strangulation of bowel.

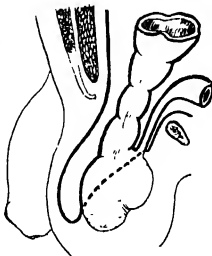
3. Richter's hernia: contains only part of the circumference of the bowel, and is most commonly found in small strangulated femoral herniæ.

4. Littre's hernia: is one which contains a Meckel's diverticulum.

5. Sliding hernia or hernia *en glissade* (Fig. 41): is one wherein viscera which are partly retroperi-

toneal are so extruded that they are incorporated in the wall of the sac. The cæcum, bladder, or pelvic colon may be involved, such herniæ usually occurring in middle-aged and elderly people.

6. Hernia of bladder. This may appear in both the inguinal and femoral regions, more commonly the latter. (1) The bladder may be pulled down to the inner side of the hernial sac (paraperitoneal). (2) Rarely the upper and posterior part of the bladder, covered by peritoneum, enters a hernial sac (intraperitoneal). (3) Still more rarely the anterior or lateral surface, free of peritoneum, protrudes without any sac (extraperitoneal). In all types frequency of micturition may be noticed, or a desire to micturate when the hernia is pressed upon.



7. Hernia of the appendix is not uncommon on the right side. It is more tender than other types, and the appendix is sometimes palpable. Attacks of inflammation may occur, with signs and symptoms referred to the sac.

FIG 41.—SLIDING HERNIA (EN GLISSADE).

8. Hernia of the ovary and Fallopian tube is more common in children and in the inguinal region; a firm rounded irreducible mass may be felt, pressure on which causes sickening pain.

Signs and Symptoms.—A rounded swelling is present which increases in size on standing or straining, and has an expansile impulse on coughing. In an uncomplicated hernia the swelling disappears on lying down, aided if need be by gentle pressure with the hand (taxis); it is then said to be reducible. If containing bowel, it is tympanitic on percussion and reduces with a characteristic gurgle; this type is often accompanied by dyspepsia and colicky pains. When omentum only is present the hernia feels soft and doughy, is dull on percussion, and reduces without a gurgle. Pain is often complained of in all types, especially in the early stages.

Complications — 1. Irreducibility. — The contents cannot be returned completely to the abdominal cavity, the causes being (a) adhesions between sac and contents or between the contents themselves; (b) contraction of the neck, (c) increased deposit of fat in mesentery or omentum; (d) raised intra-abdominal pressure. An irreducible hernia has less impulse on coughing, being often associated with indigestion, colicky pain, and a heavy dragging sensation. It cannot be adequately controlled by a truss, and is very liable to obstruction and strangulation.

Treatment.—Operation is strongly indicated, adhesions being separated and omentum removed. Before operation on large herniæ it may be advisable to keep the patient in bed on restricted diet, and to apply taxis at intervals in an effort to reduce the size of the contents. If operation is refused, the hernia may be supported by an elastic bag or a hinged-cup truss.

2. Inflammation. — Due in most cases to improper or excessive manipulation or truss pressure, setting up localized peritonitis in sac and contents. The hernia becomes painful, swollen, hot and tender, usually with pyrexia, malaise, nausea or vomiting, and constipation. While resembling strangulation in some respects, it differs in the absence of shock, in the lack of tension in the sac, and in the infrequency of vomiting. The hernia, usually umbilical or femoral, is irreducible.

Treatment.—Once strangulation has been excluded, the patient should be kept in bed on light diet, fomentations applied, and the bowels regulated by enemata.

3 Obstruction or Incarceration.—The onward passage of fæces in the gut contained in a hernial sac is prevented, but the blood supply of the bowel is unaffected. The condition is usually seen in irreducible umbilical herniæ containing large bowel, and is due to accumulation of fæces from constipation. Nausea, vomiting, colicky pain, and constipation are usually present, but the lower bowel may empty

itself and flatus be passed. The hernia is irreducible, tender and distended, but not tense as in strangulation, and the faecal contents may sometimes be indented by pressure; an expansile impulse can be detected on coughing. If neglected, inflammation and strangulation may supervene.

Treatment.—Copious enemata should be combined with gentle kneading and taxis; if not soon successful, operation should be resorted to.

4. **Strangulation.**—By this is implied constriction of the contents of a hernia in such a way that their blood supply is first obstructed and finally arrested. The passage of faeces is not necessarily interfered with, as exemplified by omental, Littré's or Richter's herniæ. Strangulation may be present on the first appearance of a hernia, usually in children, but more often results from additional contents being forced into an old-standing hernia.

The site of constriction may be (a) the neck of the sac or a narrowed part distal to it; (b) structures outside the sac—*e.g.*, Gimbernat's ligament in femoral, linea alba in umbilical hernia; or (c) adhesions or an omental aperture within the sac.

Pathology.—Venous congestion and exudation result from pressure on the thin-walled veins, until eventually the arterial circulation is arrested; gangrene is produced by this in combination with bacterial infection. If omentum only is affected, it becomes dark red or purple, infiltrated and matted; it changes to ashy-grey or brown, and becomes friable if gangrene supervenes. Intestine is at first dark red or purplish-blue, stiff from exudate and distended with gas; the peritoneal covering is for a time smooth and shiny with scattered ecchymoses, and the hernial sac contains clear or blood-stained fluid. Should the strangulation be relieved at this stage, the bowel soon recovers its tone and normal appearance, except perhaps at the site of constriction (constriction groove), where ulceration may have already started; usually it does not commence under forty-eight hours, but it may do so in less than twenty-four hours. When gangrene manifests itself, the bowel

becomes ashy-grey or black in scattered areas which later coalesce; it is soft and flabby, the peritoneal coat being rough and dull; the fluid in the sac is dark brown, turbid, and has a foul odour. Eventually the bowel gives way and the contents are discharged into the sac; this in turn may burst through the skin, when a faecal fistula is established. Gangrene is more common in femoral and umbilical than in inguinal herniæ, and more likely in small recent herniæ than in those which are large and of long standing. The bowel above the strangulation rapidly becomes distended, paralyzed, and the seat of enteritis and ulceration. When strangulation has been relieved, gangrene may still supervene from thrombosis of the mesenteric vessels or the action of bacteria on the devitalized bowel wall.

Retrograde strangulation or Maydl's hernia is a rare type wherein part of a loop of bowel re-enters the abdomen from a hernial sac and becomes strangulated.

Signs and Symptoms—1. *General*.—The picture is one of intestinal obstruction. During a sudden effort such as coughing or straining the patient is seized with acute pain localized to one of the hernial regions, or referred to the umbilicus, with a variable degree of shock during the early stages; he feels faint, is cold and clammy, the pulse slow and weak, the temperature subnormal. Vomiting soon follows, at first of stomach contents, then bilious, and finally yellowish or brown and offensive (so-called faecal vomiting). Pain meanwhile increases and spreads to the whole abdomen, which becomes tender, distended, and tympanitic. Absolute constipation is the rule after the early stages, when feces and flatus may have been passed from the lower bowel. The patient gradually becomes exhausted from pain, vomiting and toxic absorption. The onset of gangrene is sometimes accompanied by a fall in temperature and cessation of pain, but the pulse gradually becomes rapid and weaker, the face sunken and drawn, and the patient dies of toxæmia or general peritonitis.

2. *Local*.—Careful palpation of the hernial sites will disclose a tumour, or the patient may have

noticed increase in size of a pre-existing hernia. The swelling is irreducible, tense and excessively tender, with no expansile impulse on coughing. In the late stages of gangrene the skin may be discoloured and œdematous, while the tissues crepitate to the touch. In Richter's hernia—usually in the femoral region—obstruction is at first incomplete, flatus and fæces being passed; vomiting is infrequent. The tumour is small and liable to be overlooked, the constriction tight, both factors making for a bad prognosis. Strangulation in an omental hernia is rare, the symptoms being less pronounced than when bowel is involved; pain, bilious vomiting and constipation are associated with a tender hernial swelling which is seldom really tense.

Treatment.—Resolves itself into reduction by manipulation (taxis) or operation.

1. *Taxis.*—Before this is employed the patient should be recumbent, the foot of the bed raised, and an injection of morphine given (except in children). Taxis must always be very gentle and carried out with the abdominal muscles relaxed; the neck of the sac is fixed with one hand, while steady pressure is exercised on the fundus with the other. Pressure should be upwards, outwards, and backwards in an inguinal hernia, backwards in an umbilical, while in the femoral variety it should first be downwards and inwards towards the saphenous opening, and then backwards and upwards along the crural canal, the leg being kept flexed and adducted to relax the saphenous opening.

Indications.—(1) Early strangulation (2) In infants, young children, old people or those with severe visceral disease. (3) Large herniæ, especially the inguinal variety. (4) When taxis has been successful on a previous occasion.

Contra-indications.—(1) Small and tense herniæ, especially of the femoral variety. (2) Acute onset with severe symptoms in the early stages. (3) After strangulation has been present for several hours.

Risks of Taxis—The hernia may appear to be reduced, yet the symptoms of strangulation persist

for the following reasons: (1) Gangrene may supervene in the released bowel from bacterial invasion or mesenteric thrombosis. (2) Ulceration and perforation at the actual site of strangulation may lead to peritonitis. (3) Strangulation may still persist due to the bowel having passed through a hole in the omentum, or to adhesions between the contents. (4) A volvulus of the gut may be returned to the abdominal cavity still untwisted. (5) The contents of the sac may be displaced into a deep-seated diverticulum in the abdominal parietes (interstitial hernia) or from one part of an hour-glass sac into another. (6) Symptoms may be due to some cause other than the hernia. (7) Reduction *en masse* or *en bloc* should never occur, indicating as it does excessive force in attempted taxis, the sac and contents are displaced inwards and the constriction remains; on deep palpation a tense tender swelling may still be detected.

2. *Operation*—Should be undertaken with as little delay as possible. Gastric lavage is imperative, the stomach tube being left *in situ*. Local, regional or spinal anaesthesia is often indicated, especially in umbilical hernia. The sac is exposed and opened with care, the character of the contained fluid noted carefully and the contents examined. The source of constriction, when found, is stretched by the finger or divided with a hernia knife. Gentle traction is then made on the hernial contents and the site of constriction examined. In order to arrive at a decision as to whether the contents should be returned to the abdomen, the following points must be taken into account:

(1) Should the gut quickly assume a lighter shade and regain its firmness, elasticity, and shining peritoneal coat, especially if peristalsis be noted in the loop, it can safely be returned and a radical cure proceeded with.

(2) If the gut is black and dull, lacking in tone and elasticity, it should be washed with warm saline and watched for a few minutes; any change of colour warrants returning it just within the abdomen,

placing a large drainage tube in close proximity to it. Perforation or gangrene, should it occur, will then result in a faecal fistula, which often closes spontaneously later.

(3) When gangrene has set in, the fluid in the sac is offensive, the bowel wall is soft, greyish or green in hue, and the mesentery is infiltrated and dark-coloured with thrombosed vessels. Occasionally a small gangrenous area at the constriction groove can be invaginated with Lembert sutures and the bowel returned. Usually the gangrenous portion, with a margin of healthy bowel on either side, should be resected and the cut ends anastomosed; if the patient's condition precludes this course, a Paul's tube may be tied into the bowel for a few days and resection postponed, but the result is usually fatal.

After-Treatment.—Ample fluids by mouth or continuous intravenous glucose (5 per cent) in normal saline administered at the rate of 1 pint every three hours, and turpentine or ox-bile enemata (after twenty-four hours) are the main essentials. Morphine should be avoided if possible.

Post-Operative Complications.—(1) Vomiting is best treated by gastric lavage. (2) Paralytic ileus is indicated by persistent brown offensive vomit, distension, a rising pulse rate and obstinate constipation to faeces and flatus. Injections of pituitrin, pitressin, eserine or acetylcholine, enemata of turpentine or bile, antigangrene serum and gastric lavage are all of value. Gastro-intestinal decompression is essential in many cases with a Ryle's tube or preferably a Miller-Abbott tube which, being provided with an inflatable bulb, gradually passes through the small intestine and thus enables the whole gut to be emptied. Rest of the bowel may be wiser than too pertinacious stimulation. A spinal anaesthetic will sometimes produce a copious evacuation. (3) Spreading peritonitis is due to infection from the bowel after reposition, and may occur with or without perforation. (4) Acute enteritis gives rise to diarrhoea, with the passage of blood and mucus, vomiting and

abdominal pain. (5) Localized peritonitis with an intraperitoneal abscess near the hernial site is often followed by faecal fistula. (6) Fibrous stricture of the intestine, from contraction of scar tissue at the constriction groove, may cause subacute intestinal obstruction after an interval of several weeks or longer.

Varieties of Hernia.

Inguinal Hernia protrudes into or through the inguinal canal. If it extends into the scrotum or labium, it is called *complete*, *scrotal* or *labial*; if only as far as the external ring, it is termed *incomplete* or *bubonocoele*. Two main varieties occur—oblique and direct.

Oblique Inguinal Hernia extends from the internal abdominal ring along the inguinal canal, the deep epigastric artery lying to the inner side of the neck of the sac. Its coverings are (1) skin and subcutaneous tissues; (2) intercolumnar or external spermatic fascia (from external oblique); (3) cremasteric fascia and muscle (from internal oblique); (4) infundibuliform or internal spermatic fascia (from fascia transversalis); and (5) extraperitoneal fat.

Types (Fig. 42).—1. *Congenital*, in which the processus vaginalis or funicular process, leading from the peritoneal cavity to the testicle, is unobliterated. If the process communicates with the tunica vaginalis a *congenital vaginal* hernia results; more frequently it is shut off and a *congenital funicular* hernia follows. The hernia may not appear until puberty or later, and is then usually complete and liable to immediate strangulation by constricted portions of the sac. It appears more often on the right side owing to the later descent of the testicle on that side. The sac is thin and the spermatic cord closely adherent to it.

2. *Infantile or Encysted*.—An uncommon type only recognizable at operation. The funicular process is shut off from the abdominal cavity, but remains patent below and communicates with the tunica vaginalis. The hernial sac lies in front of or behind the process, or may invaginate it (see Fig. 42).

3. *Acquired*.—It is doubtful whether this ever occurs in the absence of a preformed sac derived from the funicular process.

Direct Inguinal Hernia is always acquired and the hernia passes through the inner or medial part of the inguinal canal, the deep epigastric artery and spermatic cord lying to the outer side of the neck.

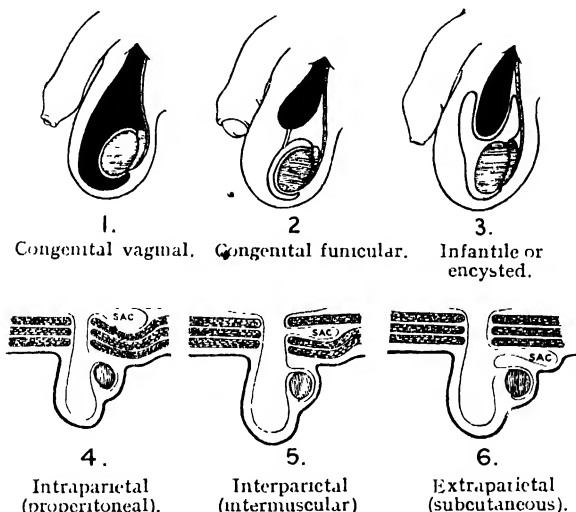


FIG. 42—ILLUSTRATING TYPES OF INGUINAL HERNIA.

4, 5 and 6 are interstitial varieties.

The hernia protrudes through Hesselbach's triangle, bounded internally by the outer border of the rectus muscle, externally by the deep epigastric artery, and below by Poupart's ligament. According as the neck lies to the inner or outer side of the obliterated hypogastric artery, the hernia is known as *internal* or *external*. Direct inguinal hernia usually occurs in males over forty years of age, is frequently bilateral,

and strangulation is unusual; should the latter occur it can generally be relieved by taxis. Allied to this form is the variety met with in younger males with good muscles, little fat, but a wide gap between the conjoint tendon and Poupart's ligament.

Interstitial Inguinal Hernia (Fig. 42) is one which develops in an unusual position in relation to the abdominal wall. Three varieties are recognized:

1. *Intraparietal* (properitoneal), in which the sac lies between the peritoneum and the transversalis fascia, and may or may not be associated with the

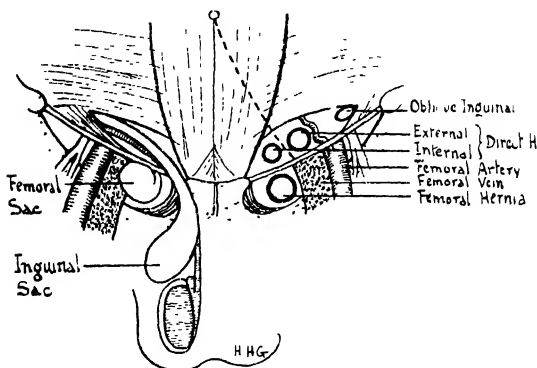


FIG. 43.—SURGICAL ANATOMY OF INGUINAL AND FEMORAL HERNIA.

usual type of sac in the inguinal canal (*hernia en bissac*). The sac may pass inwards between bladder and symphysis pubis or backwards towards the iliac fossa; no swelling can be seen or felt. Difficulties may arise after apparent reduction of a strangulated hernia, owing to displacement of the contents into such a sac.

2. *Interparietal*, the sac lying between the internal and external oblique muscles, extending upwards and outwards above Poupart's ligament.

3. *Extraparietal*.—After passing through the in-

guinal canal, which it leaves by the external abdominal ring, the hernia extends outwards along Poupart's ligament, and the swelling resembles a femoral hernia.

Interstitial hernia is frequently associated with malposition or imperfect descent of the testicle, with contraction of the scrotum.

Signs and Symptoms (see also p 421).—If the hernia is small, detection of an impulse on coughing may be difficult. When doubt exists a finger may be gently

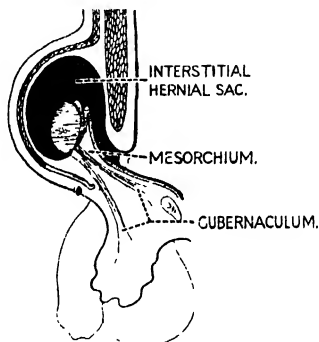


FIG. 44.—ECTOPIC TESTIS IN INTERSTITIAL HERNIAL SAC.

inserted through the external ring into the inguinal canal.

Diagnosis.—1. Bubonocoele must be distinguished from: (a) Femoral hernia, in which the neck of the sac lies below and external to the pubic spine. (b) Encysted hydrocele of the cord: this is smooth, tense, has no expansile impulse on coughing, is irreducible and can be fixed by traction on the testis; an easy distinction is afforded if the upper end can be defined. (c) Undescended testicle, pressure on which gives rise to a characteristic sensation, while the scrotum on that side is empty. (d) Chronic abscess arising within the abdomen may point in the inguinal canal, has an expansile impulse on coughing and is reducible;

it is neither so well defined nor so tense as hernia, may fluctuate, and other signs of the original disease are forthcoming. (e) Inguinal adenitis: if the glands have become adherent to the abdominal wall they appear to have an impulse on coughing, which is, however, not expansile. (f) Lipoma and other tumours in the inguinal canal: they give no impulse on coughing. (g) Hæmatocele of the cord, in which the history and signs of injury assist in diagnosis.

2. Complete or scrotal hernia may be mistaken for a hydrocele or a testicular swelling; the fullness of the inguinal canal and inability to get the fingers above the tumour are points in favour of hernia.

Treatment.—May be radical (operation) or palliative (trusses).

1. Operation is the method of choice in properly selected cases, and should be recommended for (a) children and young adults, (b) those entering the public services or going abroad, (c) those whose occupation is strenuous, (d) when pain and disability are pronounced, (e) irreducible hernia, (f) threatened strangulation, (g) hernia accompanied by undescended testicle or hydrocele, and (h) when the hernia cannot be controlled by truss pressure.

Contra-indications to operation are (a) constitutional diseases—*e.g.*, phthisis, diabetes, myocarditis, tabes, etc.; (b) diseases associated with recurrent straining—*e.g.*, chronic bronchitis, enlarged prostate, urethral stricture; (c) general weakness of the abdominal musculature associated with visceroptosis—found in elderly people; and (d) very large herniæ, in which reposition of the contents may be difficult or impossible and recurrence liable to follow.

The essential point in the operation for oblique inguinal hernia is complete removal of the sac, the neck being ligated at its junction with the parietal peritoneum; the sac in direct inguinal hernia is mobilized and reduced, rather than ligated or extirpated. Any weakness of the inguinal canal needs repair, and many methods are available for this purpose. In Bassini's operation the conjoint tendon

is sewn to Poupart's ligament behind the spermatic cord, in Foster's in front of the cord. When the muscles are weak and atrophic, Bloodgood's operation is sometimes of value: a flap of the anterior rectus sheath is turned outwards and downwards, and sewn to Poupart's ligament. Gallie's method, in which free strips of fascia lata are employed to bridge the deficiency in the abdominal wall found in all direct herniæ, has proved of great worth, and replaced filigrees of silver wire. Pedicled fascial strips cut from the external oblique tendon provide sutures with a definite if limited usefulness. Handley's method of reinforcing the gap in the canal by darning with silk or linen thread has its advocates.

In children and young adults in whom the hernia is of moderate size, no repair of the canal is needed, but great care must be taken to remove the whole sac and to avoid injuring the ilio-inguinal nerve and the cremaster muscle. Transfixion must be performed at the junction of the neck of the sac with the parietal peritoneum, a point indicated by the extraperitoneal fat. The treatment of this and other forms of hernia by attempting to obliterate the sac by injecting sclerosing fluids—*e.g.*, tannic acid—is to be deprecated.

2. Trusses are of numerous varieties: the essential feature is a pad over the hernial aperture kept in place by a spring or an elastic band, which passes transversely around the body midway between the great trochanter and the crest of the ilium, and is joined in front by straps. Various forms of pad are used, consisting of steel covered by cork and leather, vulcanite, and indiarubber cushions filled with air, water or glycerine. In oblique hernia the pad must rest over the inguinal canal; in direct hernia it should rest over the opening. If a truss is worn continuously for a year or two, especially in congenital hernia, an apparent cure may be effected, but it is not unusual for the swelling to reappear later in life.

Femoral Hernia.—A hernia protruding through the crural canal and presenting through the saphenous opening. It is more common in women, especially in those who have borne children. The coverings are

(a) skin and subcutaneous tissue, (b) fascia propria, (c) anterior layer of the femoral sheath, and (d) septum crurale and extraperitoneal fat. It does not perforate the cribriform fascia as a rule, but is deflected laterally between the superficial layer of deep fascia and the adductor longus tendon. The femoral vein lies immediately to the outer side, Gimbernat's ligament to the inner side of the neck of the sac. An abnormal obturator artery may pass between the neck and femoral vein, or along the free border of Gimbernat's ligament. After leaving the saphenous opening the hernia passes upwards and outwards below Poupart's ligament, or even above it, but the neck is always below this ligament and to the outer side of the pubic spine. The contents are usually small intestine, but omentum is not uncommon. Opinions differ as to the origin of the sac, some authorities maintaining that it is congenital, others that it is acquired.

Signs.—These are usually characteristic—viz., a more or less reducible swelling having an impulse on coughing and a neck which extends upwards by way of the saphenous opening.

Diagnosis.—(a) Inguinal hernia has a neck above and internal to the pubic spine. (b) Enlarged inguinal glands may easily be mistaken for an irreducible omental hernia, but there is no expansile impulse. (c) Saphena varix has an impulse on coughing, is reducible on pressure, and disappears when the patient lies down. It has a characteristic thrill on coughing, and fills up from below while pressure is maintained on the crural canal with the patient erect; in addition, other varices may be present. (d) Psoas abscess, pointing through the saphenous opening, is reducible and has an impulse on coughing; but fluctuation can be felt between the swelling at the saphenous opening and that which always coexists in the iliac fossa. Signs of spinal caries are also to be found. (e) Lipoma in the crural canal is circumscribed and mobile, with no impulse on coughing. (f) Ilio-psoas bursitis and femoral aneurysm may give rise to swellings which are usually easily distinguishable from hernia.

Treatment.—The principles are similar to those laid down for the inguinal variety, with a slightly increased bias in favour of operation, in view of the fact that strangulation is here more common and also more dangerous owing to the tightness of the constriction. The operation of choice is through an inguinal approach (Lotheissen's operation). The inguinal canal is opened, the spermatic cord or round ligament displaced, and the neck of the sac defined as it enters the crural canal; usually it is possible by traction on the neck to deliver the sac, which is then opened, freed of its contents and transfixed. In some irreducible herniae or if the sac be bulky it must be isolated from below, then opened and the contents separated and reduced before delivery can be achieved. It is often helpful to excise the bulbous end of a large sac before attempting withdrawal from above Poupart's ligament.

Many methods have been devised for obliteration of the crural canal; mattress sutures of catgut or kangaroo tendon passed between Poupart's and Cooper's ligaments may suffice when the opening is of moderate size, but in the remainder the best results have followed fascial grafts carried out by Gallie's technique.

Umbilical Hernia.—Three types are recognized:

1. *Congenital* (exomphalos) is rare and due to mal-development of the abdominal wall. The base of the umbilical cord is expanded, and contains viscera which may be strangulated when the cord is tied. The peritoneal cavity may be opened when the cord separates, with resultant peritonitis. Closure of the defect by sutures, after reduction of the hernia, is sometimes possible.

2. *Infantile.*—Common and appears in the first few weeks or months after birth, from stretching of the umbilical cicatrix. Constipation, phimosis, rickets and bronchitis often determine its inception. The majority of cases are cured by removal of these causes, the umbilicus being supported with strapping, but a few require plastic repair on the lines laid down below.

3. *Adult*.—Also common, the hernia protruding through the linea alba just above or below the umbilicus. The sac is thin and loculated, contains omentum and bowel (usually colon) which are matted together, the overlying tissues including the skin becoming thinned out to the point of ulceration. This type occurs in obese middle-aged multiparæ often suffering from chronic bronchitis, and forms a lobulated, rounded swelling covered by thin skin, which is not infrequently the seat of eczema. It is generally irreducible, and both obstruction and strangulation are commonly encountered.

Treatment.—Operation is the only satisfactory method for the majority, owing to the difficulty of controlling the hernia by any form of belt. Many of the patients are bad surgical risks, and special care is necessary to improve the general condition and to treat chronic pulmonary disease. Spinal anæsthesia is invaluable, lessening the incidence of post-operative chest complications and facilitating the operative technique, with a minimum of trauma. Mayo's operation is to be strongly recommended for these cases; a transverse incision is employed, the sac opened at the neck (where adhesions are least), the contents reduced and all redundant tissue removed. The aperture in the abdominal wall is closed by overlapping the edges from above downwards, using mattress sutures of strong silk for the purpose; to facilitate this manœuvre it is advisable to incise the anterior rectus sheath transversely on both sides.

Ventral Hernia.—A protrusion through any part of the anterior abdominal wall other than those already outlined. Three varieties are described:

1. **Incisional hernia** is due to the yielding of the abdominal wall in the region of an operation scar. Suppuration in the parietes or drainage of intra-peritoneal abscesses are the two most potent causes, but post-operative straining or coughing and badly planned incisions are contributory factors.

Treatment.—Operation is advisable, unless specially contra-indicated by the general condition of the patient, the large size of the hernia itself, or the

extent of the gap in the abdominal wall. Scar tissue should be excised freely and the layers of the abdominal parietes separated, when it may be feasible to suture each separately, overlapping the aponeurosis when possible. Should the gap be too large, it may be filled in by strips of fascia lata interlaced from side to side by Gallie's method; this gives excellent results. Silver wire filigrees, which were formerly employed, are open to the objection that extrusion often occurs at a later date.

2. **Epigastric hernia** (fatty hernia of the linea alba). This, which may be congenital or acquired, occurs through an aperture in either the linea alba, linea semilunaris, or one of the lineæ transversæ. Extraperitoneal fatty tissue first projects (epigastric lipoma, properitoneal lipoma) and later drags with it a pouch of peritoneum. The swelling is usually met with, above the umbilicus, in middle-aged males doing heavy work; it may be associated with severe abdominal pain and vomiting. The small, soft, rounded or lobulated tumour, which is often very tender, has an impulse on coughing.

Treatment.—If troublesome the sac and overlying fatty tissue need excision, the gap being closed and reinforced.

3. **Divarication of the recti** is seen in women who have borne children. It may be restricted to the infra-umbilical region or involve almost the whole length of the recti. When the latter are put into action, the abdomen protrudes in the centre and the edges of the muscles can be clearly felt. Symptoms may be absent or there may be bearing-down discomfort and indigestion. An abdominal belt will usually afford sufficient relief; if not, operation with overlapping of the recti gives good results.

4. **Herniæ through the linea semilunaris** tend to multiplicity and in structure resemble epigastric herniæ.

Sciatic hernia protrudes through the sciatic notch above or below the pyriformis. Strangulation is usually the first indication, but may be preceded by sciatica.

Lumbar Hernia, a protrusion between the last rib and the crest of the ilium, occurs in two forms:

1. *Incisional*, following operations on the kidney or drainage of perinephric and lumbar abscesses.

2. *Spontaneous*, appearing between the external oblique and latissimus dorsi muscles to the outer side of the erector spinae, through the triangle of Petit. This type is rare and forms a soft, reducible, rounded swelling, which may be mistaken for a lumbar abscess.

Treatment should be on the lines employed for a ventral hernia.

Obturator Hernia.—A protrusion through the upper part of the obturator or thyroid foramen into the upper and inner part of the thigh; the sac appears to be congenital, and the obturator vessels and nerves bear no constant relation to its neck. Occurring as it usually does, in middle-aged or elderly obese females, it is unlikely to be diagnosed until strangulation supervenes. Pain, radiating down the inner side of the thigh, may be associated with tenderness and fullness near the origin of the adductor muscles, and a tender swelling may be disclosed at the side of the pelvis on rectal or vaginal examination. More often than not, the abdomen has been opened for acute intestinal obstruction before the cause is found.

Treatment.—An abdominal approach affords adequate access and allows the obturator vessels to be identified. The peritoneum and obturator membrane are then nicked to allow of reduction, when the sac and contents can be withdrawn and dealt with on the usual lines.

Diaphragmatic Hernia.—These may be classified into *true* and *false* according as there is a genuine defect in the diaphragm or merely an appearance skiagraphically of a displacement of some abdominal viscus into the thoracic region. All types of diaphragmatic hernia are much commoner on the left side owing to the bulk and occlusive action of the right lobe of the liver, and some varieties are exclusively left-sided.

I. **True Hernia**—1. *Congenital.*—Here the deficiency

is nearly always in the left leaf of the diaphragm. Though congenital, the symptoms which arise may not become prominent until adult life. Almost any degree of defect may be encountered, and therefore the symptoms vary widely. Usually the stomach is found in the sac, but spleen, colon and omentum often accompany it. Dyspeptic symptoms are usual, and may resemble those of gastric or gall-bladder disorders. In the very large herniæ acute obstruction is not uncommon. The diagnosis is impossible without skiagraphy, and this may need to be carried out by examination of the patient in both the prone and Trendelenburg positions.

2. *Acquired* or *Traumatic* follows gunshot or crushing injuries, and may be associated with damage to solid or hollow viscera and with septic infection.

3. *Para-œsophageal*.—In this a small portion of the stomach protrudes through the œsophageal foramen. It is rarely the cause of serious disability.

II. **False Hernia.**—*Thoracic Stomach* results from the œsophagus ending above the diaphragmatic level, and the cardia is therefore unduly high up.

The more serious forms of diaphragmatic hernia produce symptoms of indigestion, or, when the contents are bulky and adhesions exist, of acute or chronic obstruction or strangulation. The less serious forms are often detected more or less accidentally in routine skiagraphic examination, and even if not entirely symptom-free do not as a rule justify the risks attendant on surgical treatment.

Operative Treatment.—This is to be reserved for cases in which symptoms are severe or complications such as strangulation supervene. The approach may be from below (*abdominal route*) or from above (*thoracic route*). The former should be by a left paramedian incision with, if necessary, reflexion of the costal cartilages. A stomach tube should be left *in situ* throughout the operation, and the hernial contents withdrawn into the abdominal cavity. The latter step may be facilitated by admitting air into the left side of the thorax. The margins of the opening in the diaphragm are then drawn together.

The *transpleural* route is often preferable combined with crushing of the phrenic nerve to limit diaphragmatic movements, thus facilitating closure of the gap in the diaphragm.

For *retroperitoneal hernia* see Chapter XXXVII, p. 475.

CHAPTER XXXVI

AFFECTIONS OF THE STOMACH AND DUODENUM

THE STOMACH

Injuries.—Blows on the stomach may result in *contusions*, with hæmatemesis and a moderate degree of shock of short duration, or to *rupture* of the stomach wall, usually the anterior, if the organ be distended and the trauma severe. The liver and spleen are frequently injured concurrently. Penetrating wounds are due to gunshot injuries, stabs with bayonet or knife, or swallowing of sharp bodies—*e.g.*, sword swallowing. Severe shock and collapse are shortly followed by general peritonitis, or localized perigastric abscess when the perforation is small and the stomach empty. Hæmatemesis is usual soon after the injury. Immediate operation is essential.

Foreign Bodies.—Many different objects find their way to the stomach. In children, coins, buttons, and small toys; in adults, tooth-plates, fragments of bone and pins; in the insane, glass, knives, forks, and spoons may be found. In neurotic females the habit of chewing and swallowing their hair may result in the formation of a hair-ball, which remains in the stomach for years. The majority of these foreign bodies give rise to no symptoms while in the stomach, and pass through the pylorus and intestine in the course of a week or two; those which are large and jagged may cause ulceration and even perforation, while a hair-ball may be associated with wasting, vomiting and a palpable tumour.

Treatment.—Skiagraphy is of value in localizing objects which are opaque to X-rays and in following

their course through the alimentary canal. Porridge, mashed potatoes and arrowroot should be given, aperients avoided, and the patient kept under observation. If after two or three weeks the foreign body has not passed on, it should be removed by gastrotomy. Halfpennies and shillings will nearly always pass through a child of four years or over, half-crowns or pennies through an adult.

Acute Phlegmonous Gastritis.—Swallowing of corrosives, acid or alkaline, may cause extensive necrosis of the stomach wall, involving mainly the lesser curve and pyloric region. This allows the ingress of organisms, particularly streptococci, which set up diffuse purulent infiltration or localized abscesses in the gastric wall. Occasionally a similar condition results from alcoholic excess, indiscretions in diet, gastric ulcer and operations on the stomach, and it is said to occur in puerperal sepsis. Should the patient escape perforation and peritonitis, the resultant scarring and contraction of the stomach produce hour-glass deformity and pyloric stenosis, while the œsophagus may be affected similarly. Acute epigastric pain, vomiting, restlessness, delirium, collapse and rapid pulse are the main features; the vomit usually contains blood, muco-pus and shreds of necrotic tissue. Severe toxæmia is followed by gradual exhaustion and emaciation, many patients dying of broncho-pneumonia.

Treatment.—Jejunostomy is of value in the early stage, gastro-jejunostomy or partial gastrectomy when contraction leads to deformity.

Gastric Ulcer.—Two types occur—acute and chronic. The disease is of common occurrence; the incidence of the acute type appears to be decreasing, while the chronic form is probably increasing in frequency.

1. *Acute.*—These are small, circular, funnel-shaped, ‘punched out,’ and often multiple. They are usually found on the posterior wall near the lesser curvature and at any point between the cardiac orifice and the pylorus. Young anæmic women of sedentary habits are the main sufferers, and the dyspepsia is constant. Epigastric pain after food, vomiting which fails to

relieve pain, and hæmatemesis, which may be severe but is seldom fatal, are the usual symptoms. Perforation sometimes occurs, leading to general peritonitis. Acute ulcers may also occur in both sexes as a complication of acute suppurative lesions elsewhere—*e.g.*, appendicitis. Copious hæmatemesis is the main symptom.

Treatment.—Medical measures are effective in nearly all cases, healing occurring within the space of a few weeks. Anæmia should be combated, and any source of focal infection dealt with. Hæmatemesis usually responds to rest in bed, morphine, rectal feeding and blood transfusion; surgical measures should be avoided. Perforation calls for immediate laparotomy and suture.

2. *Chronic*—The etiology of these ulcers is unknown, but the available evidence, experimental and clinical, suggests that the following factors play a part: (a) Heredity (ulcer diathesis), (b) focal sepsis, (c) chronic nervous strain, (d) irregular meals, (e) imperfect mastication, and (f) excessive smoking.

The majority of these ulcers occur in the neighbourhood of the lesser curvature, usually on the posterior wall, but later straddle the curvature (saddle ulcer). Wide variations in size and shape are encountered; they may be single or multiple (20 per cent.) The edges of the crater are thickened, rounded, œdematous and of rubbery consistence, the overlying peritoneum being injected and displaying a characteristic stippled appearance when rubbed with gauze. Microscopically the muscle coat is fragmented and inturned towards the crater, while the base of the ulcer consists of white fibrous tissue in which islands of misplaced epithelium are often seen. Penetration of the stomach wall is common, the base of the ulcer being then formed by pancreas, liver, mesocolon, transverse colon, or anterior abdominal wall. The lesser omentum is usually infiltrated, œdematous and contracted, and the coronary lymphatic glands are enlarged and soft.

Signs and Symptoms.—Males are more frequently affected (2 : 1), usually in the fourth and fifth

decades. Intermittent attacks of epigastric pain related to food and followed by vomiting are almost constant features. Usually the attacks last weeks, followed by free intervals lasting a few months. Pain may radiate to the back, chest or any part of the abdomen, usually comes on within an hour of meals, is accompanied by flatulence and relieved by vomiting. The vomit consists of undigested food, gastric secretion, and sometimes bile; it is often self-induced. Appetite is normal, but the patient is afraid to eat; loss of weight may then ensue, accompanied by constipation. Hæmatemesis or melæna may occur at any stage.

The patient may be well covered or spare, of good colour or pale, and the tongue is often furred. Epigastric tenderness and resistance is the rule during exacerbations, but may be absent between the attacks, although the ulcer is skiagraphically demonstrable.

Diagnosis.—Expert skiagraphy by screening after a barium meal gives 95 per cent. of accurate results. The ulcer can thereby be localized, its mobility or adhesion to adjacent structures determined, and any functional or cicatricial deformity of the stomach outline ascertained. Auxiliary methods are: (1) Fractional test meals, with or without preliminary administration of histamine, disclosing alterations in the total or free acid (HCl) in the gastric contents. (2) Examination of the fæces for occult blood by the benzidine or Kastle-Meyer tests. (3) Gastroscopy.

Treatment.—Early and uncomplicated chronic gastric ulcer should if possible be treated thoroughly by medical measures; this entails rest in bed, prolonged and strict dieting, administration of alkalis, abstention from smoking and alcohol, and attention to the teeth and general health. Surgery should be reserved for the following: (1) Cases in which medical treatment is impracticable for economic reasons; (2) recurrence after medical treatment; (3) ulcers of long standing; (4) penetrating ulcers; (5) those with cicatricial contraction causing pyloric stenosis, hour-glass deformity or massive adhesions; (6) cases with symptoms suggesting the onset of carcinoma—*e.g.*,

loss of appetite, constant pain; (7) perforation; (8) repeated hæmatemesis.

Partial gastrectomy by Polya's method gives the best results and is indicated in the majority of cases.

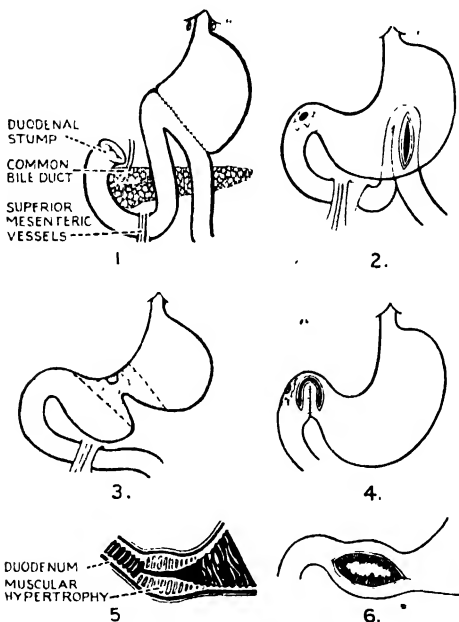


FIG. 45.—ILLUSTRATING IMPORTANT GASTRIC OPERATIONS.

- (1) Polya's gastrectomy; (2) posterior gastro-jejunostomy; (3) sleeve resection for hour-glass stomach; (4) gastro-duodenostomy; (5) congenital hypertrophic pyloric stenosis; (6) Rammstedt's operation.

The distal portion of the stomach, including the ulcer-bearing area, is removed and the cut end anastomosed to the jejunum behind the transverse colon (retro-colic); in Balfour's method the jejunum is brought

up in front of the colon (ante-colic). This operation is a serious one, and even in the best hands carries with it a mortality in the region of 5 per cent., owing mainly to the poor condition of many of the patients and the incidence of post-operative pulmonary complications. The latter may still supervene in spite of the gamut of pre-operative oral hygiene and dental extractions; local, regional, spinal, or gas and oxygen anæsthesia; respiratory exercises with administration of carbon dioxide after operation; vaccine therapy, etc. Suppurative parotitis is also to be feared, especially when prolonged medical treatment has been instituted for hæmatemesis before resort to surgery.

Objection has been raised to partial gastrectomy on the grounds that (a) unnecessarily large portions of stomach are sacrificed, (b) serious anæmia resembling the pernicious type occasionally follows, and (c) anastomotic ulcer, though rare, may supervene. The practical fact remains that 90 per cent. of patients so treated are able to resume and enjoy a normal existence and to follow their usual occupations, without the need for long periods of rest, restriction of diet and curtailment of smoking entailed by other methods.

Excision of the ulcer by knife or cautery, combined with gastro-jejunostomy, is occasionally indicated for small non-adherent ulcers high up on the lesser curvature.

Jejunostomy is of value as a temporary measure in emaciated and debilitated patients or those with very large ulcers. By this means the patient's condition improves and the inflammatory condition around the ulcer lessens, so that subsequent gastrectomy is both easier and safer.

Gastro-jejunostomy is of very limited value in gastric ulcer; it should be reserved for small ulcers close to the pylorus. In the past it was frequently employed for those in other situations, but while possibly 50 per cent. healed or improved after it, others developed anastomotic ulcers, carcinoma of the stomach at the site of the ulcer (10 per cent. at least) or at best this refused to heal. Subsequent

operative procedures, necessitated by the development of anastomotic ulcers and involving as a rule resection of the stomach and jejunum, still further militate against the practice of gastro-jejunostomy for most gastric ulcers.

Gastro-myotomy, cholecyst-gastrostomy, or resection of the stomach distal to the ulcer with the object of lessening gastric acidity are not to be recommended.

Complications of Gastric Ulcer.—1. **Hæmorrhage** results from erosion of vessels in the base of the ulcer, and may be fatal when large arteries—*e.g.*, the coronary or splenic—are involved. Sudden faintness, pallor and sweating are followed by hæmatemesis and the signs of internal hæmorrhage.

Treatment.—Rest in bed, morphine, rectal feeding and avoidance of fluids by mouth will often suffice to check the bleeding; if not, or if bleeding recurs, blood transfusion should be proceeded with, and as soon as the patient's hæmoglobin has been restored to 60 per cent. the operative measures already recommended for gastric ulcer are called for, direct access to the bleeding vessel often being feasible in the normal course of a partial gastrectomy.

2. **Perforation.**—Three types may be recognized: (a) Acute, with a large opening on a free surface of the stomach, resulting in infection of the general peritoneal cavity; (b) subacute, the opening being small and the stomach empty, leakage limited to a localized area of the peritoneum and a perigastric abscess resulting (leaking ulcer); and (c) chronic, in which preformed adhesions prevent contamination of the peritoneal cavity and a penetrating ulcer is formed.

(a) *Acute.*—A history of preceding indigestion can usually be elicited. The patient is seized with severe epigastric pain, radiating to all parts of the abdomen, after a meal or following some severe exertion. He may vomit, is cold and pale and has a slow small hard pulse with subnormal temperature. The abdomen moves poorly on respiration, is acutely tender in its upper part and to a lesser extent in the lower, and is tight and rigid ('hard as a board'). Liver

dulness may be absent in the right mid-axillary line. Within a few hours pain, tenderness and rigidity become less, but the pulse rate increases, and soon the signs and symptoms of spreading peritonitis are manifest. It is essential to remember that with a small perforation and an empty stomach all the symptoms and signs may be so modified that diagnosis is particularly difficult.

Treatment.—Immediate operation is imperative, statistics showing indubitably that the mortality increases with every hour of delay. On opening the peritoneum, gas, watery fluid, flakes of lymph and particles of food may escape. The perforation is seen as a circular hole which may be plugged with lymph, the surrounding stomach wall being indurated and oedematous. Interrupted catgut sutures are inserted to approximate the stomach wall over the perforation; unless large bites are taken with the needle, the stitches will cut out owing to the friable condition of the tissues. In perforations near the pylorus the stitches should be inserted in the long axis of the stomach to avoid constricting its lumen. The omentum should then be brought up to the region of the perforation and anchored by catgut sutures. Excess of fluid and particles of food are evacuated by an aspirator or by gentle mopping with gauze. Drainage should be provided for in all cases with gross contamination, usually through a stab wound in the suprapubic region, the main incision being closed. Gastro-jejunostomy, although sometimes advised, adds materially to the risks, and is contra-indicated unless obvious stenosis of the pylorus is present. The Fowler position, restricted fluids by mouth for forty-eight hours, and special care to avoid pulmonary complications are the main points in after-treatment.

(b) *Subacute.*—In this variety the onset is also sudden, with severe epigastric pain which remains localized, but the general disturbance is less. Signs and symptoms of local peritonitis develop, and an intraperitoneal abscess forms either in the lesser sac or elsewhere in the subphrenic region.

(c) *Chronic*.—This gives rise to a penetrating ulcer, the presence of which may be inferred by the pain becoming more constant and radiating to the back, especially when the pancreas is involved.

3. *Pyloric Stenosis*.—Narrowing of the pyloric orifice in gastric ulcer is mainly the result of cicatricial contraction of the lesser curvature, producing kinking of the pyloric canal, but is not infrequently due to an accompanying duodenal ulcer. [Other causes of stenosis are (1) carcinoma of the pylorus, (2) duodenal ulcer, (3) congenital hypertrophic stenosis, (4) adhesions from cholecystitis, (5) extra-gastric pressure from abdominal tumours.]

The stomach wall is thickened and the viscus dilated, retention of food interfering with normal digestion and allowing organisms to set up fermentation and decomposition. In cases due to gastric or duodenal ulcer there is a history of long-standing dyspepsia, which may have recently become constant. Vomiting becomes a pronounced feature, unrelated to pain or to meals, and tends to increase in volume; the vomit is sour, frothy and brownish, and may contain food ingested days or weeks before. Wasting is pronounced and gastric tetany occasionally seen, fibrillary muscular twitchings being associated with carpo-pedal spasms.

The distended stomach can often be detected through the thin abdominal wall by recognizing visible peristalsis from left to right, and by the obvious succussion splash which can be elicited many hours after food or fluid has been taken. Skiagraphy discloses the degree of obstruction and sometimes its cause.

Treatment.—Gastro-jejunostomy is ideal for those cases due to cicatrizing ulcers—duodenal or gastric—in the neighbourhood of the pylorus, but is not advisable for those due to large gastric ulcers on the lesser curve; for these partial gastrectomy is indicated. Pre-operative gastric lavage with normal saline, intravenous glucose (5 per cent.) in normal saline in conjunction with insulin hypodermically, and blood transfusion are valuable adjuncts to success.

4. **Hour-Glass Stomach.**—The body of the stomach is deformed by fibrous contraction accompanying or following a gastric ulcer. In active ulcers the deformity is often exaggerated skiagraphically by spasm of the greater curvature opposite the ulcer. Two sacs are formed connected by a narrow channel, and in many cases pyloric stenosis is present from a concomitant duodenal ulcer. The condition is mainly confined to thin middle-aged women suffering from visceroptosis, and the clinical picture is almost identical with that of pyloric stenosis. Skiagraphy affords a certain means of diagnosis and has superseded other methods.

Treatment. — Partial gastrectomy by Polya's method or sleeve resection of the stomach with end-to-end anastomosis has replaced gastropasty, gastro-gastrostomy, and double gastro-jejunostomy.

Anastomotic Ulcer.—Gastro-jejunostomy is liable to be followed in 4 to 5 per cent. of cases by the development of an ulcer at the suture line (gastro-jejunal) or in the efferent loop of the jejunum (jejunal). The transverse colon, mesocolon, omentum and pancreas become infiltrated and matted; perforation into the colon, which is not uncommon, results in a gastro-colic fistula. The cause of these ulcers is unknown, but their incidence is undoubtedly higher when the gastro-jejunostomy has failed to effect early and adequate neutralization of the free acid in the gastric juice, a fact supported by animal experimentation and demonstrable by fractional test meals. They are more common after operations for duodenal ulcer, particularly in young men with hyperchlorhydria and a rising test meal curve, and after anterior or en-Y-gastro-jejunostomy (Roux's operation), also when pyloric occlusion has been efficiently carried out. Errors of technique, resulting in too small an opening, and the use of unabsorbable sutures may play a part.

Symptoms are usually noticed within eighteen to twenty-four months of the operation; pain is below and to the left of the umbilicus, usually severe,

and worse two to three hours after food; vomiting, hæmatemesis and melæna are common, wasting is marked, tenderness and resistance are the rule, while a mass may be palpable in the region of the ulcer.

Treatment.—Operation offers the only hope of cure, but should never be undertaken lightly owing to the magnitude of the procedures which may be called for. The crux of the operation is to free the anastomosis from surrounding structures, and this may be both tedious and difficult owing to the dense adhesions usually encountered; should the colon be opened inadvertently, the hole should be sutured with great care. If the original ulcer has healed and the pylorus be patent, resection of the affected loop of jejunum and adjoining portion of stomach should be followed by closure of the opening in the stomach and end-to-end anastomosis of the jejunum. Usually the original ulcer is found to be still active, in which case resection of the jejunal loop, with end-to-end union of the cut ends, must be combined with partial gastrectomy by Polya's method. Jejunostomy as a preliminary to radical measures is of great value in debilitated patients, combined with repeated blood transfusions when anæmia is pronounced.

Acute Dilatation of the Stomach.—A condition which is often fatal, occurring after (*a*) abdominal operations and injuries; (*b*) operations on other parts; (*c*) debilitating diseases—*e.g.*, pneumonia and typhoid fever; and (*d*) indiscretions in diet. The onset is sudden, epigastric pain and distension being followed by effortless vomiting of large quantities of fluid, at first greenish and later brown and offensive. In some cases the patient does not vomit, the other symptoms being if anything then more intense. The patient becomes restless, with intense thirst, rapid pulse and increased respiration rate. The upper abdomen is distended and tympanitic, with marked succussion splash, but no visible peristalsis. The cause is unknown, the dilatation usually involving the duodenum and sometimes the jejunum in addition to the stomach. It has been attributed to (*a*) toxic

paralysis of the neuromuscular mechanism analogous to paralytic ileus, or (b) obstruction of the duodenum by the superior mesenteric vessels.

Treatment.—Frequent gastric lavage with an indwelling Ryle's tube, continuous intravenous glucose saline, and nursing in the prone position with the pelvis raised are of value in early cases. On no account should operation ever be undertaken.

Gastric Fistula may be external or internal.

1. *External.*—May follow a perigastric abscess which opens on the surface, a wound or operation on the stomach, penetration of a gastric or gastro-jejunal ulcer and carcinoma of the stomach. The escaping gastric juice excoriates and digests the skin, and the patient may waste. If spontaneous healing does not occur within a reasonable time operation is required.

2. *Internal.*—Of these the only common variety is gastro-colic, which may result from carcinoma of stomach or colon, gastric ulcer, perigastric abscess, and anastomotic ulcer. Diarrhoea, the motions containing undigested food, may supervene soon after taking a meal; offensive eructations and vomiting of faecal material are features, the latter pathognomonic. Wasting is often pronounced.

Treatment.—Operation is required to deal with the fistulous track and if possible remove the cause.

Gastroptosis.—The stomach is displaced downwards and usually dilated, often in conjunction with generalized visceroptosis (Glénard's disease). Abdominal discomfort, flatulence, vomiting, hæmatemesis, constipation and loss of weight are often associated with symptoms of neurasthenia. The patient, usually a woman, is thin and sallow with a lax abdominal wall, and the distended stomach is often visible. Rovsing's sign (visible epigastric aortic pulsation) is often obtainable. Fractional test meals disclose a low acidity, skiagraphy a delayed emptying time.

Treatment for neurasthenia should be the primary consideration; careful dieting, abdominal massage and a well-fitting belt are useful adjuncts. All opera-

tions, such as gastropexy, gastroplication and gastrojejunostomy, are heartily to be condemned.

Congenital Hypertrophic Pyloric Stenosis.—An affection of unknown etiology found in young infants, often breast-fed males, during the first few weeks of life. The pylorus and adjacent portion of stomach are considerably thickened from muscular hypertrophy, and obstructive symptoms result presumably from active spasm or failure of the circular muscle to relax. The presumption is that abnormality of the sympathetic innervation or inco-ordination of the neuromuscular mechanism is responsible (*cf.* Achalasia and Hirschsprung's disease).

The infant takes its feeds normally and the weight increases usually until the third to fifth week, when for no apparent reason expulsive or projectile vomiting sets in; the vomit consists of undigested food containing no bile, and is brought up within a few minutes of a feed. Emaciation and constipation are pronounced. The dilated stomach is sometimes obvious; gastric peristalsis may be visible after a feed and the pyloric mass palpable to the right of the umbilicus. An opaque meal may help in doubtful cases.

Treatment.—Eumydrin in doses of 1 to 5 c.c. of 1 : 10,000 solution given by mouth twenty minutes before each feed will frequently cure cases in which muscle spasm rather than hypertrophy is responsible for the symptoms. Gastric lavage combined with frequent small feeds will usually improve the general condition and the prospects after operation. Rammstedt's operation under local anaesthesia (see Fig. 45) has replaced all other methods—*e.g.*, pyloroplasty, Loreta's operation; the mortality is between 5 and 10 per cent and the results excellent, provided skilful nursing is available. Whenever possible the mother's milk should be procured by a breast pump for after-feeding.

Innocent Tumours.—Fibroma, myoma, myxoma, lipoma, adenoma and angioma are all rare, but may give rise to a palpable tumour, pyloric obstruction or hæmatemesis.

Carcinoma of the Stomach.—Gastric carcinoma is

of very frequent occurrence—slightly more so in men than in women—the usual age being forty to sixty years, but many younger patients are seen. In 10 to 15 per cent. of cases the growth originates in a chronic gastric ulcer.

Pathology.—The neoplasm may arise at the pylorus (70 per cent.), on the lesser curve, or rarely in other situations; many of those at the cardiac end are squamous-celled and originate in the œsophagus. To the naked eye the growth may present as a (1) large proliferating nodular mass projecting into the body of the stomach, (2) small and fibrous growth at the pylorus causing early obstruction, (3) crateriform ulcer, with nodular edges which may be raised, near the pylorus or lesser curve, (4) diffuse infiltration of the stomach wall, which is rigid and thickened (leather - bottle stomach). Microscopically both spheroidal and columnar-celled types are seen, colloid degeneration is not unusual, and excess of fibrous tissue may be present (scirrhus); in one uncommon variety (linitis plastica) epithelial cells may be hard to find owing to the preponderance of fibrosis.

The main direction of spread is through the sub-mucous coat towards the cardia, duodenal extension being rare. The peritoneum covering the stomach may be infiltrated, and adhesions to pancreas, liver, transverse mesocolon, colon and abdominal wall follow.

Lymphatic Spread (see Fig. 46).—The growth may spread via the lymphatics to glands in the following situations: (1) Along the lesser curvature and around the coronary artery; (2) behind the pylorus and on the head of the pancreas; (3) in the portal fissure; (4) along the greater curvature and throughout the greater omentum; (5) at the root of the neck on the left side (Virchow's gland) by way of the thoracic duct. Spread may also take place to the umbilicus along the falciform ligament and to the recto-vesical pouch and ovaries (Krukenberg tumours). Enlargement of the glands does not always imply malignant infiltration, being often due to infection from the ulcerated growth. In the later stages metastases are common in the liver.

Pyloric stenosis, hour-glass stomach (rare), perforation, perigastric abscess and gastric fistula are complications.

Signs and Symptoms.—In the early stage vague indigestion is the only symptom. If it persists for a few weeks in a patient of over forty years it calls urgently for skiagraphy by an expert before having

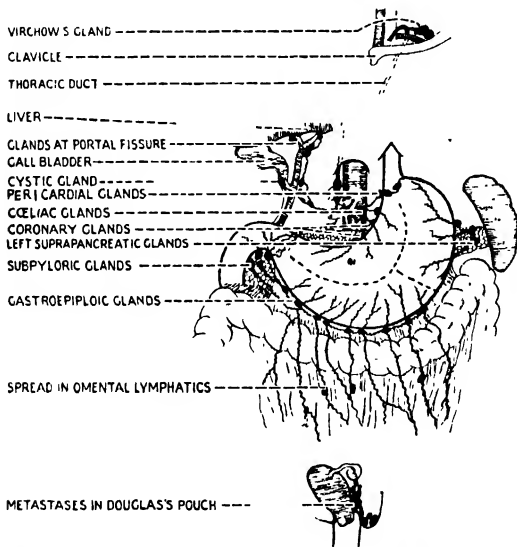


FIG 40.—LYMPHATIC SPREAD IN CARCINOMA OF THE STOMACH.

recourse to other measures—*e g.*, alkaline treatment, dieting and dental extractions—which often result in temporary amelioration of symptoms. Unless this course is followed, valuable time is lost and progress in the treatment of cancer of the stomach cannot be made.

Later symptoms are epigastric pain, which tends to be persistent but is aggravated by food, diminution

of appetite and loss of weight; vomiting, the material resembling coffee grounds, may be a feature, but it does not relieve the pain (*cf.* gastric ulcer). Hæmatemesis, dysphagia or symptoms of pyloric obstruction sometimes occur.

The patient is often well covered and by no means pale at the time investigation is called for; the sallowness so often evident, which may approach the lemon tinge of pernicious anæmia, is usually a late manifestation, but may be the first sign of the disease. Epigastric tenderness and resistance are usually present, only too often with a palpable tumour which is hard and irregular, and may be movable or fixed. As the disease advances, enlargement of Virchow's gland, subcutaneous nodules at the umbilicus, a mass in Douglas's pouch, irregular enlargement of the liver with jaundice, distension of the abdomen with ascites, or thrombosis in the leg may be evident. Progressive wasting with anæmia leads to death from cachexia within a few months.

The supervention of carcinoma on chronic gastric ulcer may be so insidious that it is unsuspected until extensive infiltration has taken place. The pain, however, tends to become more constant, is not relieved by vomiting, and the appetite diminishes.

Diagnosis.—Expert skiagraphy has superseded all other methods and gives 95 per cent. of accurate results. Gastroscopy is only second to skiagraphy in diagnostic value. Fractional test meals, with or without administration of histamine, may confirm the diagnosis by revealing a combination of achlorhydria with high total acidity due to organic acids, but in some early cases the curve is within normal limits, and occasionally is of the rising type with an excess of free hydrochloric acid (*cf.* duodenal ulcer). Examination of the fæces for occult blood is usually positive, and is then of value in doubtful cases; in the latter, persistence of blood in the stools after strict dieting and rest in bed for a week or two is sufficient justification for an exploratory operation.

Treatment.—Early radical extirpation affords the only hope of cure, though the insertion of radon seeds

in inoperable cases may give relief and prolong life for periods up to two years. Subtotal gastrectomy should be performed, the major part of the stomach from pylorus to just below the cardia, together with the great and lesser omenta plus the glands and areolar tissue in the region of the celiac axis artery, being excised *en bloc*. Careful preparation of the patient, including gastric lavage, intravenous glucose saline and blood transfusion, combined with gas and oxygen and regional anæsthesia, are essentials for success. The operative mortality nevertheless is still in the region of 20 per cent. Metastases in the liver, peritoneum and more distant sites preclude radical operation, whereas local infiltration of liver, pancreas or colon can occasionally be met by including the affected portions of these organs in the extirpated mass. Palliative gastro-jejunostomy for cases with pyloric obstruction, gastrostomy for those near the cardia, or jejunostomy when diffuse infiltration is present, avert starvation and prolong life.

Sarcoma is rare, may be round or spindle-celled (fibro-sarcoma), and is rather more common in women, usually between the ages of thirty and fifty years. Signs and symptoms may simulate those of carcinoma of the stomach, or a large abdominal swelling develops resembling an ovarian tumour; in the latter type there is no digestive disturbance.

Syphilis of the Stomach.—This rare lesion occurs in the late tertiary stage, affects the submucosa of the lesser curvature near the pylorus, reveals itself as multiple gummatous ulcers or diffuse fibrosis, and simulates in the former a carcinoma and in the latter the deformities associated with peptic ulcer. Hæmatemesis, melæna and cachexia are the chief phenomena of these lesions, which often fail to respond to anti-syphilitic remedies.

THE DUODENUM

Diverticulum.—An uncommon congenital pouch in which intestinal contents may stagnate, giving rise to dyspeptic symptoms. It is frequently multiple,

and projects as a rule from the inner side of the second part of the duodenum. It may lie in close relation to the ampulla of Vater and lead to obstruction of both hepatic and pancreatic ducts. The pouch can be clearly defined by skiagraphy after a barium meal, but should only be removed if it gives rise to symptoms. Pseudo-diverticula are due to distortion caused by cicatrization of ulcers.

Rupture.—The duodeno-jejunal flexure is commonly torn after crushing injuries, and should the tear be retroperitoneal, the condition is very liable to be overlooked, fatal cellulitis supervening. Skiagraphy may disclose a localized translucent area from the presence of free gas.

Duodenal Ulcer.—This is even more common than gastric ulcer, the majority of cases (75 per cent.) occurring in men between thirty and fifty years of age. Many younger cases are seen, and it is relatively more frequent in those whose occupation entails concentrated mental effort and strain. The etiology is similar to that of gastric ulcer. Duodenal and gastric ulcers may coexist.

The ulcer occurs nearly always within an inch of the pylorus—*i e.*, where the acid chyme impinges on the duodenal wall, well above the entrance of the alkaline bile and pancreatic juice. In most cases the ulcer is single and situated on the anterior wall, but a second ulcer may be present on the opposite side (kissing ulcer). The overlying peritoneum is often thickened, characteristic stippling is present, and adhesions to the gall-bladder, pancreas or colon are not infrequent.

Signs and Symptoms.—Intermittent attacks of epigastric pain lasting for several weeks alternate with months of freedom. The pain may radiate to the chest or shoulder, across the abdomen or through to the back, coming on two to three hours after food or wakening the patient at night. It is usually relieved by taking more food, by alkalies, or by vomiting, which is for this reason often self-induced. The appetite is good, but the patient is afraid to eat, and there is often constipation. In some the con-

dition is latent, and hæmatemesis, melæna or perforation may be the first indication. The patient is sometimes well covered, but usually spare, and often pale. Localized epigastric tenderness, resistance and hyperæsthesia are the rule during the attacks.

Diagnosis.—Expert skiagraphy will enable this to be arrived at in over 90 per cent. of cases. Fractional test meals, by revealing a high total acidity due to free hydrochloric acid, associated with a rising curve at the end of two hours, may prove of great value. Occult blood in the fæces is also a helpful diagnostic feature if positive.

Treatment.—The indications for surgery are similar to those discussed under gastric ulcer, with the exception that the supervention of carcinoma in duodenal ulcer is not to be feared. The choice of operation lies between gastro-jejunostomy and duodeno-gastrectomy, each of which has its special indications. Gastro-jejunostomy is of value in cases with pyloric obstruction, in old and feeble patients, and those suffering from pulmonary diseases. It may be the only alternative when the large size or fixation of the ulcer precludes duodeno-gastrectomy. The mortality is 1 to 2 per cent., and the operation results in 80 to 90 per cent. cures, provided restricted diet, abstention from smoking, avoidance of worry and overwork, are maintained for a long period; oral or other focal sepsis should be eradicated. Duodeno-gastrectomy should be reserved for ulcers in younger patients (usually men) with a high rising test meal curve, for those in which hæmorrhage or perforation has occurred previously, and those associated with gastric ulcer or carcinoma. In most cases it is unnecessary and undesirable to extirpate more than one-half to two-thirds of the stomach. An alternative to gastro-jejunostomy is gastro-duodenostomy (Finney's operation), which sometimes enables excision of a small ulcer to be combined with it. It has the disadvantage of being technically more difficult, while on the other hand, if ulceration follows at the site of anastomosis, it is far less amenable to treatment.

Hæmorrhage and perforation should be treated as indicated under gastric ulcer (see p. 446).

Carcinoma.—In contrast to the stomach, the duodenum is rarely the seat of carcinoma, and there is no relation between the incidence of the latter and that of duodenal ulcer. The growth usually arises in the second part at or close to the ampulla of Vater, producing, in addition to duodenal obstruction, jaundice and symptoms of pancreatic disease. Excision is sometimes possible, but usually cholecyst-jejunostomy or gastro-jejunostomy is needed for the relief of symptoms.

Duodenal Fistula may follow penetrating wounds, but is usually a sequel to gastrectomy or nephrectomy. It may heal under continuous suction drainage.

CHAPTER XXXVII

AFFECTIONS OF THE INTESTINES—INTESTINAL OBSTRUCTION

Meckel's Diverticulum.—In 2 per cent. of people a lateral outgrowth of the ileum may be found within 3 feet of the ileo-cæcal valve; this pouch is due to persistence of the intestinal end of the vitelline duct (omphalo-mesenteric duct). The diverticulum may extend to the umbilicus in the form of a hollow tube lined by mucous membrane, forming a congenital fistula (see p. 408). It is more usually patent for an inch or two only, ending in a fibrous cord attached to the umbilicus or mesentery, or lying free in the abdomen.

Complications.—1. Inflammation. This is usually acute and results in catarrh, gangrene or perforation, followed by spreading peritonitis or a localized intraperitoneal abscess. The signs and symptoms are so like those of appendicitis that distinction is usually impossible before operation. The treatment is on similar lines.

2. Intestinal obstruction. Strangulation of a loop of intestine by the fibrous cord, and volvulus of the

portion of ileum containing the diverticulum are not uncommon.

3. Intussusception of the enteric type (see p. 480). The diverticulum is the starting-point of the invagination.

4. Torsion, of the diverticulum only, is followed by gangrene and peritonitis.

5. Littré's hernia.

6. Intraperitoneal cysts, lined by an intestinal or gastric type of epithelium, and having pancreatic tissue in the wall, may be the only indication of the persistence of the vitelline duct.

7. Peptic ulceration at the fundus of a Meckel's diverticulum may, by erosion of mesenteric vessels, induce severe anæmia.

Megacolon (*Hirschsprung's Disease, Congenital Dilatation of Colon*).—An unusual condition in which the sigmoid and descending colon may be enormously dilated. The rectum is often involved, sometimes the remainder of the colon, but seldom the anal canal. The wall of the bowel is thickened by muscular hypertrophy and overgrowth of fibrous tissue, sacculation is lost, and stercoral ulcers may result from faecal accumulation. No mechanical obstruction is present, and the condition would appear due to incoordination of the autonomic system leading to muscular spasm at the lower end of the affected segment.

Signs and Symptoms.—Boys are those usually affected. The main symptom is steadily increasing constipation, often noticed during the first year of life. Abdominal distension increases, and may be so marked that respiration and circulation are embarrassed. Emaciation becomes pronounced, and death may result from toxæmia or perforation of the bowel. In those that survive to adult life there is said to be a tendency to spontaneous amelioration in later years.

Treatment.—Irrigation of the colon, abdominal massage and electrical treatment may effect marked improvement, but must be persevered with to avoid relapse. Presacral sympathectomy combined with section of inferior mesenteric nerves is of considerable

value, and its probable effect may be estimated by observing skiagraphically the result on the bowel of a spinal anæsthetic following a barium enema; if active contraction and evacuation take place, the operation is indicated. The parents should be warned that sterility follows on this operation in males.

Visceroptosis (Glénard's Disease).—Prolapse of the abdominal viscera is frequently found in women at all ages, often in association with a thin frame, sagging breasts, sallow complexion and general loss of muscle tone; it may also be met with in men. Loss of weight from serious illness, or weakness of the abdominal muscles from repeated pregnancies, may be causes, but the vast majority of cases are congenital. The prolapse may be general or most marked in certain organs—*e.g.*, stomach, liver, kidney or colon.

In many cases no symptoms result for years, but the onset of neurasthenia, to which these patients are particularly liable, is responsible for a variety of symptoms which may be confused with organic abdominal disease. Loss of weight, dragging abdominal pain, lassitude, dyspepsia and constipation are frequently encountered, while in many cases gastric or duodenal ulcer, gall-stones, carcinoma of stomach or colon, appendicitis and renal calculus are closely simulated. Careful examination, both clinical and radiological, will usually enable differentiation, but great care must be exercised to avoid overlooking organic disease in patients with obvious visceroptosis.

The displaced viscera are often dilated and distended with gas, the lower abdomen protuberant in the erect posture, the abdominal wall thin, and the tongue furred. Signs of neurasthenia are usual, and skiagrams disclose the real nature of the condition.

Treatment.—Neurasthenia should be treated; rest in the recumbent position, a generous fattening diet, abdominal massage and a well-fitting belt are specially indicated. Surgery is not only useless but harmful, the apparent improvement so often seen from measures such as appendicectomy, division of the various 'bands,' 'kinks' and 'membranes,' colopexy,

nephropexy, or even excision of the colon, being the result of gross suggestion and frequently followed by more crippling symptoms due to the added psychic trauma of the operation.

Fæcal Impaction.—The contents of the lower bowel accumulate, becoming dry and hardened, and fill the rectum and more or less of the colon with hard masses of fæces (scybala). In varying degrees the condition is not uncommon in old people, especially women suffering from chronic constipation. Abdominal discomfort, colicky pain, nausea and vomiting may be associated with rectal tenesmus and spurious diarrhœa, with muco-purulent or blood-stained rectal discharge. On examination tender masses, which are often hard, but may be indentable by the finger, can usually be felt scattered along the line of the colon; the rectum is filled by scybala or by a mass of softer fæces.

Treatment.—The bowel can often be emptied by repeated injections of olive oil or by enemata, but occasionally an anæsthetic is required to break up and remove per rectum the accessible fæcal mass.

Typhoid Perforation.—This usually takes place in the second or third week of the disease, but may occur during convalescence, or be the first sign in ambulant cases. The incidence is about 3 per cent., and the perforation, which may be multiple, is usually in the ileum within 3 feet of the ileo-cæcal valve, but occasionally in colon or appendix. The diagnosis is often extremely difficult owing to the grave condition of the patient and the absence of physical signs other than those of the original disease. Abdominal pain, tenderness and distension are often present without perforation; collapse, rigidity and a rising pulse rate are strongly suggestive of perforation. Immediate laparotomy through a right infra-umbilical paramedian incision, closure of the perforation by Lembert sutures, and drainage are called for; the possibility of a second perforation must be borne in mind.

Ulcerative Colitis.—A disease mainly confined to young adults, often proving fatal from exhaustion and intercurrent infections. The onset is insidious,

diarrhœa being the main symptom, sometimes associated with abdominal pain. The stools are offensive, containing mucus, blood and pus; on culture a hæmolytic streptococcus is sometimes found. Perforation of the colon or serious hæmorrhage may occur. Sigmoidoscopy is often necessary to differentiate from amœbic dysentery; the granular mucosa dotted with small ulcers is diagnostic, as is the skiagraphic appearance with a barium enema.

Treatment.—Medical treatment, by colonic irrigation and dieting, is often effective, but may need to be supplemented by chemotherapy. Appendicostomy or cæcostomy — preferably the latter — permits thorough irrigation of the colon, while ascending colostomy has the virtue of resting the affected bowel as well. In intractable cases it may be justifiable to perform a low terminal ileostomy so as to exclude the large bowel. Restoration of the *status quo ante* should be delayed months or years to avoid relapse.

The profound secondary anæmia of advanced cases needs repeated whole blood transfusion and perforations may require urgent laparotomy for suture of perforation or eventration of the perforated loop if feasible.

Diverticula of the Colon.—In many people of middle age and over, especially obese males who suffer from chronic constipation, a number of saccular projections may be found in the descending and pelvic colon, and occasionally in the other parts of the large bowel in addition (diverticulosis). They consist of hernial protrusions of the mucous membrane through areas in the bowel wall where the vessels pierce the muscle layers. They often invade the mesocolon and appendices epiploicæ (see Fig. 47). Stagnation of fæcal material in these diverticula may lead to the formation of inspissated concretions, followed by inflammatory changes of an acute or chronic nature:—

1. *Acute Diverticulitis.*—As in the appendix, gangrene and perforation may lead to spreading peritonitis or localized intraperitoneal abscess. The signs and symptoms are indistinguishable from those of appendicitis, but with their maximum intensity on the left side, and treatment involves drainage, suture

of the perforation followed by colostomy just above the affected segment.

2. *Chronic Diverticulitis*.—This is more often seen, low-grade infection of a segment of the colon leading to excess of fibrous and fatty tissue, especially in the submucous coat, thickening and induration of the wall and contraction of the lumen. The peritoneal covering becomes inflamed and roughened, adhesions form to the abdominal wall or bladder, and a fistulous opening between the latter and the colon may result.

Signs and Symptoms.—Carcinoma of the colon is closely simulated by certain chronic types. Constipa-

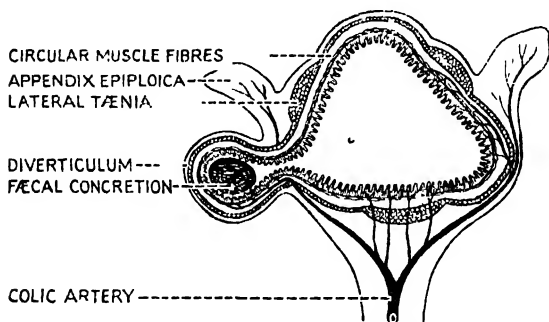


FIG. 47.—ILLUSTRATES MODE OF PRODUCTION OF DIVERTICULOSIS.

tion, colicky abdominal pain, distension and loss of weight may coexist with the passage of mucus in the stools, and at any time acute intestinal obstruction may supervene. Perforation into the bladder results in cystitis, with foul-smelling urine, sometimes with the passage of flatus per urethram.

A tender, hard, fixed mass may be felt in the left iliac fossa or on rectal examination. Skiagraphy after a barium enema discloses a narrowing of the affected bowel, which differs from the stenosis of carcinoma in being elongated and tubular, while isolated diverticula are often seen. (See Fig. 48.)

Treatment.—Colonic irrigation, with suitable diet and liquid paraffin by the mouth, should be given a trial in uncomplicated cases. The principles of surgical treatment in vesico-colic fistula are to treat the cystitis, limit operation to colostomy and to keep the latter open for prolonged periods before attempting closure or colectomy. The extirpation of the

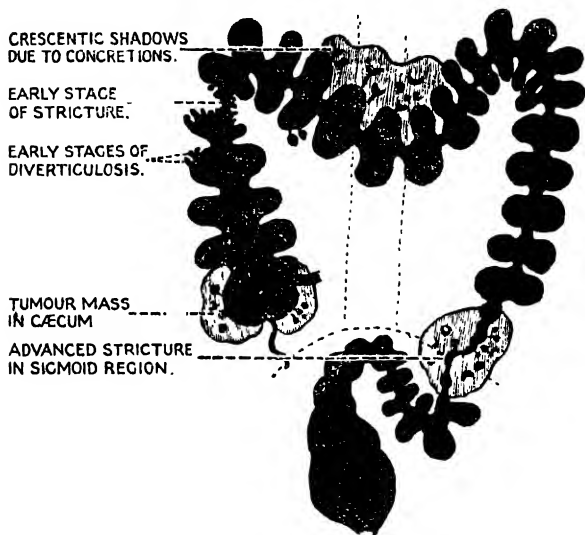


FIG. 48.—DIAGRAM OF SKIAGRAPHIC APPEARANCES IN DIVERTICULOSIS AND DIVERTICULITIS.

fistulous track needs condemnation owing to the prohibitive risks.

Tuberculosis.—Two forms occur:

1. **Hyperplastic.**—Is mainly confined to the terminal ileum, appendix and cæcum (ileo-cæcal), but may affect part of the colon. Commencing as a sub-mucous infiltration, the bowel wall becomes indurated and thickened with excess of fibrous tissue, the

lumen contracted, and the peritoneum thickened and adherent to adjacent structures. The mesenteric glands may be infiltrated and caseous, while cold abscesses form and sinuses may follow rupture of an abscess on to the surface. This type is found in young adults of both sexes (twenty to forty years), giving rise to indigestion, irregularity of the bowels and loss of weight, followed by chronic intestinal obstruction. A tender, hard, nodular mass, which may be movable or fixed, is often felt in the right iliac fossa. Diagnosis from carcinoma is often impossible, even after the abdomen has been opened.

Treatment.—Resection of the terminal ileum, cæcum and ascending colon, preceded by end-to-side union of ileum and transverse colon, gives good results. If excision is not practicable the affected bowel should be short-circuited.

2. **Ulcerative.**—Multiple ulcers in the lower ileum occur in young patients, often in conjunction with phthisis or tuberculous peritonitis. They tend to encircle the bowel and lead during healing to strictures which, added to the matting and kinking from adhesions, may cause intestinal obstruction. Chronic perforation may lead to a cold abscess which bursts through the umbilicus, forming a fæcal fistula. Surgical treatment is restricted to dealing with obstruction by means of a short circuit.

Crohn's Disease, often erroneously termed *regional ileitis*, since it may involve any part of the small and sometimes the large bowel as well, is a non-specific chronic inflammatory disease which usually affects the lower ileum of young adults. It is probable that many cases of so-called 'hyperplastic tuberculosis' should be included under this heading. The bowel becomes greatly thickened and rigid and its lumen reduced. Abscesses may form in the bowel wall and perforation and peritonitis ensue. Diagnosis is made by skiagraphy, and excellent results follow resection of the affected segment.

Stricture of the Intestine.—Several varieties occur:

1. *Congenital.*—Rare, but may be seen in the jejunum, ileum, and at the flexures of the colon.

2. *Inflammatory*.—May be caused in different ways—viz.: (a) by healing of an ulcer, tuberculous in the small intestine, dysenteric in the colon, syphilitic or gonococcal in the rectum; (b) following strangulated hernia, as the result of contraction at the site of the constriction groove; (c) After reduction of an intussusception from cicatrization at the neck; (d) as the result of pressure by an adhesion or band outside, or of an impacted foreign body within the bowel; and (e) from ulceration at the base of a Meckel's diverticulum.

3. *Traumatic*.—Following injuries or operations—e g., intestinal anastomosis or suture of perforations.

4. *Malignant*.—Due to contraction accompanying scirrhus carcinoma.

Signs and Symptoms.—In the small intestine very few symptoms result until the onset of acute intestinal obstruction from kinking or adhesions. In the large bowel signs and symptoms of chronic or sub-acute obstruction are the rule. Skiagraphy after an opaque meal or enema will usually locate a stricture in the colon, but is of limited value in small intestine stenosis.

Treatment.—Resection of the affected portion with end-to-end union is the method of choice. When excision is impracticable, short circuit by lateral anastomosis is usually followed by good results. Enteroplasty, incising the strictured bowel longitudinally and sewing it up transversely, is seldom possible. Should obstruction be present, preliminary drainage is essential before resection is undertaken.

Fæcal Fistula.—An abnormal track discharging intestinal contents and opening on the skin surface.

Causes.—(1) Congenital; is occasionally seen at the umbilicus as a result of a patent Meckel's diverticulum. (2) Injury of the bowel from penetrating wounds or after operations. (3) Sloughing of the bowel wall after strangulated hernia, appendicitis, or when drainage tubes have been employed. (4) Perforation of the bowel by foreign bodies. (5) Tuberculosis, actinomycosis, diverticulitis or malignant disease.

The opening into the bowel is usually small, and unless there is obstruction distal to the fistula, only a small amount of the contents escapes. The length of the track varies, and when short it may be lined by mucous membrane which protrudes at the skin opening.

Signs—Jejunal fistula discharges watery fluid containing bile and undigested food, and causes redness, excoriation and ulceration of the skin, the patient wasting rapidly. Ileal fistula discharges alkaline fluid which is less irritating, and excoriation is not so marked. Cæcal fistula discharges liquid faeces, colic fistula semi-solid or solid material.

Treatment.—Time should be allowed for the fistula to heal spontaneously, which the majority will do unless (a) there is obstruction in the bowel below, (b) foreign bodies or concretions are present, or (c) mucous membrane protrudes at the skin surface. Excision of the fistulous track with suture of the opening in the bowel may be possible; alternatively resection of the affected loop of bowel with end-to-end anastomosis is needed.

Neoplasms of the Intestines.

1. *Small Intestine*—(a) *Innocent*.—Adenoma is the least rare, may be multiple, and shows less tendency to malignancy than in the colon; fibroma, lipoma, papilloma and myoma have also been recorded. They all tend to become pedunculated and to lead to intussusception, and may cause serious hæmorrhage or obstruction.

(b) *Malignant*.—Carcinoma is very rare, usually in the lower ileum, and produces intestinal obstruction at a late stage. Sarcoma is less rare, occurs in children, and may form a pedunculated tumour or infiltrate the wall of the bowel; emaciation is an early symptom. Secondary carcinoma is not uncommon and often multiple.

2. *Large Intestine*—(a) *Innocent*.—**Multiple adenomata** (polyposis intestini) are occasionally seen involving the descending and pelvic colon, and as a rule the rectum; they form soft bright red tumours,

pedunculated or sessile, which are very inclined to undergo malignant changes. They tend to run in families, and are usually seen between the ages of twenty and forty years, causing diarrhoea, tenesmus, loss of weight and anæmia; the stools contain blood and excess of mucus. Excision of the colon may be the only course following permanent ileostomy, but involves a high risk.

(b) *Malignant*.—**Carcinoma** occurs frequently in the colon, usually in the pelvic portion, but also in the cæcum and ascending colon, splenic flexure, transverse colon, hepatic flexure and descending colon in this order of frequency. It forms a growth of low malignancy in the majority, local infiltration and invasion of glands occurring slowly, while metastases are seen in the late stages only. The growth is frequently amenable to surgical extirpation, and the prognosis after removal is good.

Pathology.—Histologically the appearances are often typical—a columnar-celled adeno-carcinoma, the cells of which show obvious indications of their origin from the intestinal glandular epithelium, sometimes with colloid degeneration. Four anatomical types are met with: (a) *Scirrhus* is the type usually seen in the pelvic colon. It forms a small tumour with excess of fibrous tissue which encircles the bowel and leads to a stricture (annular or ring stricture). Proximal to the growth the bowel is distended and hypertrophied, its walls may be inflamed, stagnation of fæcal matter leading to stercoral ulcers which may perforate; the distal bowel may be contracted, or dilated and atonic. (b) *Papilliferous or hypertrophic*: A fungating cauliflower-like growth projects into the lumen of the bowel. It is liable to ulceration, of low malignancy, and there is a tendency to colloid degeneration. The usual sites are the cæcum and ascending colon, where chronic intussusception may result. (c) *Ulcerative*: Here the growth tends to infiltrate deeply with early glandular spread. (d) *Tubular*: A comparatively long segment of bowel is involved.

In the region of the growth the mesocolon and

appendices epiploicæ usually contain an excess of fat, and inflammatory adhesions to the abdominal wall, omentum, and other loops of intestine are often encountered. Not infrequently insidious perforation is followed by a pericolic abscess close to the bowel, but occasionally retroperitoneal cellulitis occurs and produces a fixed indurated mass. Extension of the growth takes place by submucous infiltration and by lymphatic spread to the glands in the mesocolon, metastases appearing later in the liver and peritoneum. Vesico-colic, gastro-colic and ileo-colic fistulæ are occasionally met with.

Signs and Symptoms.—The disease occurs mainly in those of middle age, more frequently males, and the patients are often well covered. In the early stages vague abdominal discomfort, flatulent dyspepsia and increasing constipation may be noticed. As the disease progresses the clinical features vary according to the position and type of growth.

1. *Growths in the cæcum, ascending colon and hepatic flexure.* Pain, often related to food, in the region of the growth, occasional vomiting, flatulent distension and a palpable tumour are the main features. Diarrhœa is often present, sometimes constipation, and occasionally peristalsis is visible in the peri-umbilical region. Anæmia is common.

2. *Growths in pelvic, descending and transverse colon.* Obstructive symptoms predominate. Increasing constipation alternates with spurious diarrhœa, during which the stools contain excess of mucus and often blood. The abdomen becomes distended and tympanitic, borborygmi and colicky pain are experienced, and sooner or later acute obstruction sets in. Abdominal distension is then usually pronounced, vomiting slight or absent, peristalsis may be visible, and hiccup is sometimes prominent; the rectum is ballooned. Before the onset of complete obstruction a tumour may be palpated in the region of the transverse or pelvic colon, and in the latter it may also be felt on rectal examination.

Diagnosis.—Skiagraphy after a barium enema is of great value, often disclosing a stricture in the

obstructive type or a filling defect in others. Sigmoidoscopy is of use for growths low down in the pelvic colon, and examination of the stools for occult blood may help. In suspicious cases laparotomy may be called for to clinch the diagnosis.

Treatment.—1. The method of choice is radical excision of the affected portion of colon with all the corresponding mesocolon and contained lymphatics, followed by end-to-end, end-to-side, or lateral anastomosis. The amount of bowel to be excised is determined by the fact that the lymphatic drainage of the affected part corresponds to the area supplied by one of the main vessels—*i.e.*, ileo-colic, right, middle or left colic arteries. Preliminary drainage, with rigorous irrigation of the bowel for a period of at least two weeks, is advisable in nearly all cases before resection, but may be omitted in the proximal colon in the absence of evidence of obstruction. For this purpose cæcostomy should usually be performed. Alternatively the principle of complete exclusion of the affected colon by a 'disconnecting anus' may be applied. This permits of the colon being reduced to such a degree of cleanliness by irrigation and by exclusion of faecal matter that axial anastomosis can be undertaken with a minimum of risk, the 'anus' being closed formally at a later date. In growths of the cæcum and ascending colon the terminal ileum should be cut across and the proximal end implanted into the side of the transverse colon.

2. Paul-Mickulicz operation. The affected part of the colon is mobilized and delivered through an overlying abdominal incision, the proximal and distal ends of the loop being sutured together and to the abdominal wall; the loop of colon is then excised and a Paul's tube inserted into each end, either at once when acute obstruction is present, or after an interval of a few days in other cases. At a subsequent stage the spur between the bowel ends is crushed with a special clamp, so as to allow the intestinal contents to pass into the distal portion of bowel and the fistulous opening to close. This operation is of considerable value in patients who are poor surgical

risks, in those of marked obesity, and when mechanical factors—*e.g.*, rigid abdominal wall owing to imperfect anaesthesia—render the more radical excision both hazardous and difficult. A modification of this method, in which the two ends of the colon after the resection are sealed for a day or two with de Martel's clamps, is sometimes preferable.

3. Colostomy, or short circuit by lateral anastomosis, should be performed when (a) the growth cannot be mobilized owing to infiltration of the abdominal wall, (b) the lymphatic glands are enlarged and fixed, or (c) metastases are present in liver or peritoneum.

INTESTINAL OBSTRUCTION

Intestinal obstruction is a condition in which the passage of faeces and flatus through the bowel is delayed or prevented. It must be distinguished from strangulation of the bowel, in which there is interference with the blood supply. Intestinal obstruction is often present without strangulation, but strangulation nearly always results in obstruction except possibly in a Littre's or Richter's hernia. The condition may be mechanical or paralytic in origin and acute or chronic in type. There are three varieties; (a) Acute, (b) Acute on Chronic, and (c) Chronic.

Acute Intestinal Obstruction — Pathology. — The bowel proximal to the obstruction is distended and usually reddened, congested and oedematous, that distal to it is contracted, pale and firm. There is usually clear fluid in the peritoneal cavity. Peritonitis, due to the passage of organisms through the bowel wall or from necrosis and perforation of the distended proximal bowel, occurs in the later stages. The explanation of the high mortality of acute obstruction is still obscure. By some it is considered to be due to toxins absorbed from the bowel above the occlusion. The toxins may be proteoses, the result of the action of ferments on the bowel contents, or due to the effect of bacteria on the bowel wall. There is an increased indicanuria. In high obstruction there is a great

loss of chlorides and fluids, resulting in a severe grade of alkalosis. The blood becomes greatly concentrated and the non-proteid nitrogen may rise as high as in uræmia. The changes present in strangulation have already been dealt with (see p. 423).

Causes.—(a) *External to the bowel*: Abdominal tumours, cysts, strangulation in hernial sacs, by peritoneal bands and adhesions, or through apertures in the mesentery. (b) *In the wall of the bowel*: Neoplasms, fibrous stricture, intussusception, volvulus, diverticulitis, congenital abnormalities, thrombosis or embolism of mesenteric vessels, enterospasm. (c) *Within the bowel*: Impaction of foreign bodies, gall-stones and fæcal concretions.

Signs and Symptoms.—The umbilical region is usually the site of onset of sudden severe pain which becomes generalized; at first colicky and intermittent, it eventually becomes constant and less intense. Vomiting, at intervals of a few minutes, is an early symptom in high (small intestine) obstruction, but may not appear for some days when the occlusion is in the distal colon. It soon becomes effortless and precipitate, the vomit consisting first of stomach contents, later bilious, and finally yellowish or brown with an offensive odour. Shock is often pronounced in the first few hours, the temperature being subnormal, the pulse weak and the skin cold and clammy. Absolute constipation of both fæces and flatus is present, although frequently there is a history of a motion being passed after the onset of pain. In the early stages little information can be obtained from examination of the abdomen, which is flat, soft and not tender. Later, distension and in thin patients peristalsis may be visible, while slight diffuse tenderness is to be elicited. Increased peristaltic sounds may be detected on auscultation. The pulse increases in rate but decreases in strength, the tongue becomes dry and brown, the eyes and features sunken (*facies Hippocratica*), and the body livid, cold and clammy. The higher in the intestine the obstruction, the more marked the shock and vomiting and the less the distension.

Treatment.—The primary indication is to restore fluid and chlorides to the circulation. This is best effected by continuous intravenous infusion of blood plasma, but if this is not available 'double-strength' saline is indicated, avoiding, however, excess of either fluid or chlorides. In many cases it is desirable to empty the stomach and maintain it so by means of a Ryle tube. Even more efficient is the Miller-Abbott tube, which has a distal inflatable bulb which is grasped by the duodenum and passes onwards to the region of the obstruction, permitting the toxic contents of the dilated bowel to be withdrawn. When the patient's condition is ameliorated, laparotomy should be performed through a paramedian incision below the umbilicus. The site of the obstruction can be determined by noting the state of the caecum or following the distended bowel down, paying it gently through the hand. The cause should then be ascertained, removed if possible, gangrenous bowel resected, and the abdomen closed. Should the cause be irremovable, as is usually the case in the colon, drainage of the distended bowel is indicated. Cecostomy, colostomy, or enterostomy should be performed. After-treatment is as laid down for strangulated hernia.

The following conditions are the principal causes of intestinal obstruction.

Peritoneal Adhesions. Account for 60 per cent. of cases of acute intestinal obstruction and the most common cause of this condition in young adults. At the same time it must be realized that in many cases adhesions are symptomless, and as a rule the more widespread the adhesions the less the likelihood of obstruction. Adhesions produce acute obstruction through kinking or twisting of a loop of bowel or by actual strangulation, the onset and symptoms being more acute in the latter. Gradual obstruction is brought about by (a) fixation of a loop of bowel, (b) localized constriction, (c) cicatricial contraction of the mesentery, or (d) extensive matting.

Varieties.—1. *Peritoneal.*—Any form of peritonitis may give rise to a considerable variety of adhesions:

(a) thin transparent membranes between viscera, (b) isolated narrow bands resembling string or cord and sometimes several inches in length, and (c) thick opaque layers of tissue.

2. *Omental*.—Arise in the same way and are frequently seen in hernial sacs.

3. *Visceral*.—Any mobile viscus covered by peritoneum may become adherent to other structures and act as a band liable to cause strangulation—*e.g.*, the vermiform appendix, Fallopian tube, an appendix epiploica, or Meckel's diverticulum.

Signs and Symptoms.—Vague abdominal discomfort, with occasional attacks of colicky pain and vomiting, may occur intermittently for years before the onset of chronic or acute obstruction. There is often a history of previous abdominal disease or of an abdominal operation. Acute obstruction usually involves the small intestine, is of sudden onset, with severe pain, collapse and frequent vomiting.

Treatment.—Laparotomy with division of adhesions is called for when the definite symptoms indicated above are present. Warning is necessary here against the indiscriminate opening of the abdomen for symptoms due to neurasthenia in patients with visceroptosis. Often they will have been needlessly operated upon previously; the adhesions will probably recur and the neurasthenic state is in any case intensified.

Retroperitoneal Hernia.—May occur in any of the following situations:—

(1) *Duodeno-jejunal*.—Anatomists describe three main recesses of peritoneum—*viz.*, paraduodenal, superior and inferior duodenal fossæ. Duodenal hernia is either *right* or *left*; the former passes behind the mesentery of the jejunum towards the ascending colon, the latter extends down behind the transverse or descending colon. Strangulation may occur at the neck of the recess, which in the right hernia contains the superior mesenteric artery and vein, the left hernia being related to the inferior mesenteric vein; high intestinal obstruction results, with frequent vomiting and profound shock. At operation the neck of the

fossa must be gently stretched and never divided (see above), the opening being obliterated if possible by suturing the edges.

(2) *Cæcal*.—Although there are four named peritoneal recesses the hernia usually passes behind the cæcum and ascending colon (retrocolic), and strangulation gives rise to obstruction low down in the small intestine. At operation the opening of the pouch should be closed by sutures after removal of the appendix.

(3) *Sigmoid* —This is the rarest situation, the bowel passing into the intersigmoid fossa near the bifurcation of the left common iliac artery, and between the layers of the pelvic mesocolon. In the anterior margin of the neck of the fossa lie large sigmoid arteries.

Abnormal Peritoneal Apertures are occasionally responsible for strangulation of bowel, and may also be the cause of vague dyspeptic symptoms and colicky pain. The mesentery of the lower ileum, the great omentum and the transverse mesocolon are the most important sites. Some may be of congenital origin, others the result of abdominal injuries, while operations are undoubtedly responsible for certain cases—*e.g.*, apertures in the transverse mesocolon following gastro-jejunostomy.

Volvulus.—A condition in which a loop of bowel is twisted on its mesenteric axis; 75 per cent. occur in the pelvic colon; it is less common in the cæcum and rare in the small intestine. Volvulus neonatorum affects the whole mid-gut of the newly-born.

1. **Pelvic Colon**.—The shape and mobility of the sigmoid loop, the narrow attachment of its mesentery to the abdominal wall, adhesions from previous peritonitis, and constipation are factors in the causation of volvulus at this site. The amount of rotation varies from a half up to two or three complete turns; this, together with the degree of constriction at the base of the mesentery, determines the issue. If the circulation is impaired, strangulation and complete obstruction follow, otherwise incomplete obstruction is the result.

Pathology.—The most marked feature is the enormous and rapid dilatation of the twisted loop, which becomes purplish-black and œdematous; gangrene and perforation are not uncommon, and the peritoneal cavity contains blood-stained fluid.

Signs and Symptoms.—Men between forty-five and sixty-five are those usually affected, and there is frequently a history of constipation. The onset is sudden, with severe pain and rapid distension of the abdomen involving primarily the left side. Tenderness is not long deferred, and is at its maximum in the left iliac fossa. Tenesmus may be severe, intractable hiccup sometimes present, but vomiting is rarely conspicuous. The extreme distension eventually embarrasses respiration. Without operation death is usual in two to three days, though the outlook is always grave even after relief of the obstruction.

Treatment—The abdomen should be opened and an attempt made to pass a rectal tube beyond the twist in order to relieve the distension; if unsuccessful, the bowel must be punctured with a trocar, and the opening closed with a purse-string suture. If feasible the torsion is then corrected, though adhesions may render this impossible, in which case cæcostomy should be performed and the twisted loop itself separately drained or the loop everted, as in Paul's operation. Should the patient survive, resection of the affected segment may be undertaken at a later date.

Recurrence is to be feared unless steps are taken to fix the affected loop to the abdominal wall. If this fails, resection of the pelvic colon may be needed.

2. *Ileo-cæcal.*—For this to occur the mesentery of cæcum and ascending colon must be abnormally long. The condition is less acute than in the case of the pelvic colon, vomiting is more pronounced, distension less marked, but the torsion is often more difficult to correct.

3. *Small Intestine.*—Peritoneal adhesions are usually responsible for this type, which is rare. Palpation may reveal a mass in the central part of the abdomen.

Obstruction by Obturation.—This may be brought about by:

1. **Large Gall-stones.**—These reach the intestine via a fistulous opening between gall-bladder and duodenum and become wedged in the lower ileum, partly owing to their size, partly from muscular spasm. The condition is usually met with in obese women of fifty to sixty-five who have suffered for many years from flatulent dyspepsia and constipation. Repeated and progressive vomiting is a marked feature. In spite of this, both fæces and flatus may be passed. At first the vomit is bilious and may contain blood, later it is yellow or brown and offensive. The symptoms are sometimes intermittent and the physical signs usually indefinite, these facts accounting for the delay in operation and the resulting high mortality. Abdominal tenderness and rigidity are slight, but the stone may occasionally be palpated per abdomen or rectum.

Treatment.—At operation the calculus should be displaced into the bowel above the site of impaction and removed through a longitudinal incision.

2. **Enteroliths and Fæcal Concretions.**—These may be produced by the accumulation of various substances which have been ingested—*e.g.*, insoluble drugs such as magnesia or calcium carbonate, indigestible foodstuffs, etc. When resulting from chronic catarrh of the bowel, they consist of phosphates and carbonates of calcium and magnesium.

3. **Fæcal Accumulations** (see p. 462).

4. **Foreign Bodies.**

Intussusception.—The invagination of one portion of bowel into an adjoining segment: it occurs in both acute and chronic forms.

1. **Acute Intussusception.**—The majority of these affect young children under the age of two years. The invaginated bowel is the *intussusceptum*, the portion into which invagination takes place the *intussusciens*. The three layers of bowel from within out are designated the *entering*, *returning* and *ensheathing* layers respectively. The *apex* is at the extreme limit of the invagination, where the entering

and returning layers join, and is usually the site at which the intussusception commenced; the *neck* is

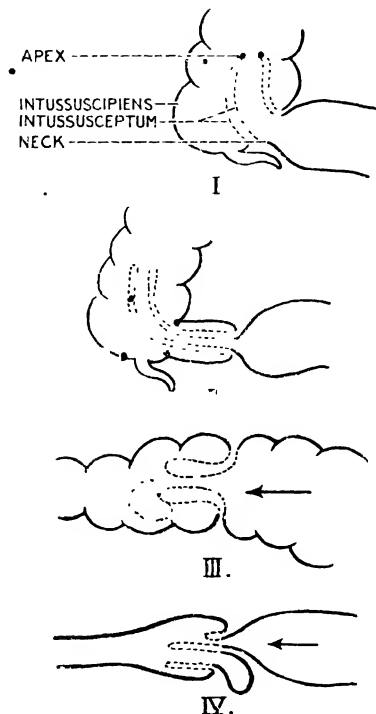


FIG. 49.—ILLUSTRATING VARIETIES OF INTUSSUSCEPTION.

I., Ileo-cæcal; II., ileo-colic; III., colic; IV., enteric (caused by Meckel's diverticulum).

at the opposite end, where the invaginated bowel and its mesentery enter the ensheathing or outer layer. An intussusception is usually progressive, increase

taking place, as a rule, at the expense of the outer layer; as this proceeds the vessels in the invaginated mesentery become compressed, until finally strangulation and gangrene result. Plastic peritonitis determines adhesions between the various layers and may render the condition irreducible; should gangrene supervene, adhesion of the layers at the neck may prevent spread of peritonitis, and by this means spontaneous recovery exceptionally ensues, the gangrenous part being passed per rectum. The mass formed by an intussusception is tense and elastic from œdema, curved by the traction of the mesentery, and usually described as sausage-shaped.

Etiology.—In children no organic cause is as a rule found, with the occasional exception of a Meckel's diverticulum. It is therefore assumed to be due to irregular peristalsis, a surmise supported by the frequent history of constipation or diarrhœa, and the increased prevalence at times when dietary indiscretions are rife—e.g., birthday celebrations. In adults, polypoid tumours or other diseased conditions of the bowel wall are sometimes the starting-point.

Varieties.—(1) *Entero-colic*.—Accounts for the majority (80 per cent.) of acute cases, especially in children under the age of two years, and occurs in two forms:

(a) *Ileo-cæcal*.—The apex is formed by the ileo-cæcal valve and remains constant, increase taking place at the expense of the cæcum and colon.

(b) *Ileo-colic*.—At first the terminal ileum is invaginated through the ileo-cæcal valve, and the apex is therefore changing; later the valve itself and cæcum become invaginated, the apex remaining constant.

(2) *Colic*.—Affects the large bowel only, is practically confined to adults, and usually due to a tumour or polyp of the colon.

(3) *Enteric*.—Is composed entirely of small intestine, usually jejunum, and is caused by an intestinal polyp or some irregularity of the bowel wall.

Double or triple intussusceptions, though rare, have been recorded.

Signs and Symptoms.—The majority of cases arise

in well-nourished children under two years of age—more often boys; there may be a history of diarrhœa and vomiting. The onset is sudden, the child screaming with pain, the face pale, and the knees drawn up, followed shortly by vomiting and in many cases a normal action of the bowels. Attacks of pain recur at short intervals and within a few hours the bowels may be opened several times, the motions consisting of mucus streaked with blood. In the intervals between the attacks the child appears abnormally quiet; its colour may improve, but the eyes remain sunken. Abdominal examination often discloses an abnormal emptiness in the right iliac fossa (*signe de Dance*). In many cases a firm smooth tumour can be felt along the course of the colon; it is usually slightly mobile and may harden coincidently with an attack of pain. Combined rectal and abdominal examination, with or without an anæsthetic, is of great value in cases of doubt and should never be omitted. Per rectum the apex of the intussusception may be felt in the pelvic colon as a soft rounded mass with a central depression. On withdrawing the finger, blood-stained mucus is seen. If the condition is unrelieved the child's appearance deteriorates rapidly, the abdomen becomes distended and spreading peritonitis sets in.

Gastro-enteritis and Henoch's purpura may cause difficulty in diagnosis: in the former, vomiting and diarrhœa are more pronounced, the motions contain faecal material, and there is no palpable tumour; in the latter, purpuric spots and joint tenderness are present. Prolapse of the rectum is more easily differentiated.

Treatment.—The abdomen should be opened, preferably under spinal anæsthesia, the intussusception located, and gentle pressure exerted on the bowel distal to the apex; by this means reduction can usually be effected until the last part is approached, when, owing to the œdema of the apex, it may be necessary to exercise firm pressure for a few minutes to obtain reduction of the last inch or so of the bowel. On no account should traction be employed on the entering

loop owing to the danger of rupturing the friable tissue. Great care is essential in all cases to ensure that reduction is complete, as owing to the œdema of the ileo-cæcal region a small invaginated portion of ileum may easily be overlooked, the condition then recurring within a few days. Before the abdomen is closed it is advised by some that the cæcum should be sutured to the right iliac fossa, the appendix being removed if the child's condition justifies it.

If the attempt at reduction fails, owing to excessive œdema and hæmorrhagic exudate, the heroic measures referred to below are seldom successful in children under the age of two years. In older children or adults the affected bowel should be resected, continuity being restored by anastomosis. Short circuiting, formation of an artificial anus, delivery of the bowel on to the abdominal wall, or removal of the intussusceptum through an incision into the intussusciens (Jesett's operation) can seldom be recommended.

2. Chronic Intussusception.—The colic type is often due to neoplasms or inflammatory conditions of the bowel. In others no apparent cause can be found and the entero-colic variety predominates. Adhesions between the layers and ulceration of the implicated bowel are the rule. A rare retrograde type may follow gastro-jejunostomy, the jejunum becoming invaginated into the stomach.

Signs and Symptoms.—The majority occur in adults—twice as often in men. Attacks of colicky abdominal pain and vomiting are frequently associated with diarrhœa and tenesmus, the stools often containing blood and an excess of mucus. The abdomen is distended, peristalsis is often visible, and palpation will usually disclose a sausage-shaped tumour which varies in size and shape, as well as in the facility with which it can be felt from time to time. The patient tends to become emaciated and anæmic, while acute obstruction is the usual termination.

Treatment.—The bowel should be drained for a few weeks, followed by resection of the affected portion with restoration of continuity.

Mesenteric Vascular Occlusion.—Mesenteric thrombosis is seen occasionally in cirrhosis of the liver and also in intestinal strangulation. Embolism of one of the mesenteric arteries or veins, usually the superior, may occur in endocarditis, atheroma or pyæmia. The affected bowel becomes paralyzed, intestinal obstruction ensues, and gangrene may follow. The signs and symptoms of acute small-intestine obstruction will be found, distinctive features being intense pain and shock followed by rigidity of the abdominal wall, the passage of stools containing blood, and sometimes an ill-defined palpable tumour. There is a less common 'chronic' variety in which there is a history of recurrent attacks of colic with bloody stools over a period of months or years before a final acute fulmination occurs. Resection is associated with a high mortality, particularly as the thrombosis may extend after operation, but something can be done to prevent this by an intravenous saline drip containing heparin.

Enterospasm.—Spasm of the circular muscle of the pelvic colon, occasionally of other parts of the large bowel, is sometimes encountered in neurotic women of twenty to fifty. It gives rise to attacks of abdominal pain, vomiting, distension and absolute constipation. The attacks may last for anything up to several days, during which the contracted bowel may be felt as a firm elastic thickening in the left iliac fossa. Colitis usually precedes or accompanies the attacks and a history of blood in the stools may serve to indicate the cause. The diagnosis of enterospasm should always be made with great circumspection to avoid the danger of overlooking other forms of obstruction. If full doses of antispasmodics—*e.g.*, atropine—do not afford rapid and complete relief from symptoms, laparotomy should be performed.

Paralytic Ileus (Adynamic Ileus).—A form of intestinal obstruction due to paralysis of the bowel wall.

Causes.—(1) Abdominal operations which have been prolonged or associated with (a) excessive or rough handling of the bowel, (b) forcible retraction of the wound edges, or (c) overcooling of the bowel

from exposure to the air. (2) Peritonitis, spreading or localized. (3) Mesenteric thrombosis or embolism. (4) Injuries or diseases of the spinal cord. (5) Lead poisoning and uræmia.

Signs and Symptoms.—The onset is usually heralded by persistent vomiting of brown offensive fluid, abdominal distension, a rising pulse rate, and obstinate constipation for both fæces and flatus. The temperature becomes subnormal, the extremities cold and livid, the eyes and features sunken, but there is *complete absence of pain* and the patient may feel remarkably well, failing utterly to appreciate the gravity of the situation.

Treatment.—It is imperative to start this at the first indication—*i.e.*, distension, rising pulse rate or vomiting. Details are given on p. 427.

Acute on Chronic Obstruction.—The only common site is the colon, the causes being malignant neoplasms and diverticulitis. The general features are those of acute obstruction with a history pointing to the chronic cause. Treatment is by laparotomy, cæcostomy for operable obstruction, colostomy or short-circuiting for inoperable lesions.

Chronic Intestinal Obstruction—Pathology.—Distension and muscular hypertrophy characterize the bowel proximal to the obstruction, the mucous membrane being often inflamed and the seat of multiple ulcers (stercoral ulcers). In obstruction of the colon the distended cæcum may be so thinned out that perforation occurs.

Signs and Symptoms.—Gradually increasing constipation may be punctuated by attacks of spurious diarrhoea, with frequent small stools containing excess of mucus and sometimes blood. Flatulence, colicky abdominal pain (worse after a meal), abdominal distension and occasional vomiting are the main symptoms.

When small intestine is obstructed abdominal distension is mainly in the umbilical region, in the epigastrium and flanks when large bowel is involved. Peristalsis is sometimes visible, especially after the abdominal wall has been lightly massaged. Exaggerated peristaltic sounds are heard on auscul-

tation. When the condition has existed for some weeks or more, the complexion is often sallow, the tongue thickly furred and the breath offensive, loss of weight being sometimes pronounced.

Common Causes.—In children: Tuberculous peritonitis. In young adults: Tuberculosis of the bowel. In middle-aged adults: Diverticulitis and chronic intussusception. In elderly people: Carcinoma of the colon or rectum.

Treatment.—Operation is usually advisable to remove the cause if possible; alternatively to avert the danger of acute obstruction, by colostomy or short circuiting.

CHAPTER XXXVIII

AFFECTIONS OF THE APPENDIX

Appendicitis.—Inflammation of the appendix is by far the most common emergency met with in surgical practice and would appear to be on the increase.

Etiology.—Civilization undoubtedly plays an important part, but whether from dietetic errors—*e.g.*, an excess of meat or lack of 'roughage'—constipation, heredity or other factors, is problematical. Mild epidemic infections, usually termed influenza and associated with tonsillitis, frequently bring in their train an increased number of cases of appendicitis. When the preponderance of lymphoid tissue in the wall of the appendix is taken into account, support is lent to the view that the appendix is in the nature of an 'abdominal tonsil.' Local factors, such as kinking or strictures of the organ from congenital or acquired causes, which prevent the normal emptying process, are often present.

Pathology.—Two main types are usually differentiated—*viz.*, acute simple and acute obstructive appendicitis—but there are many in which this rigid distinction is not possible. Infection with pyogenic organisms may be *hæmatogenous* and lead to any grade of inflammatory reaction, from catarrhal to

gangrenous, but perforation is unusual, though peritonitis is common. In mild cases resolution may be complete, but in many fibrosis of the muscular and submucous coats is left, often in the proximal third of the organ. The fibrous stricture thus produced may prevent complete emptying; the contents inspissate, forming a faecal concretion. Reinfection at some future date is thereby favoured, usually with more serious results. Localized ulceration and gangrene of the wall, from pressure of the concretion and inflammatory exudate combined, may end in perforation. Interference with the circulation may result in thrombosis of the appendicular vessels, leading to massive gangrene of the appendix. In this type the infection arises from the contents of the appendix and perforation is relatively common. Distension of the distal part with pus (empyema) or mucus (mucocele) may occur, the latter sometimes leaking into the peritoneal cavity, producing an accumulation of large amounts of jelly-like material (pseudomyxoma peritonei). Lymph is deposited on the inflamed peritoneal coat, which adheres to adjacent structures, usually the ileum, abdominal wall or omentum. The succeeding stages are decided by the virulence of the organism and the resisting powers of the peritoneum; localization of the process may result in resolution or in the formation of an appendicular abscess; failure to localize the infection determines spreading peritonitis.

Signs and Symptoms.—The disease is more common in the male. It may be encountered at any age, the maximum incidence being from twenty to thirty years, and very few cases occur in infancy or old age. The attack may commence without warning or be preceded by vague abdominal discomfort, indigestion, constipation, diarrhoea, or sore throat, with aching pains in the limbs. The onset is sudden, with severe abdominal pain usually referred to the periumbilical region, but difficult of localization; this is generally accompanied by nausea, with or without vomiting. The temperature and pulse are often unaffected, and the only physical sign at this stage is deep-seated tender-

ness in the right iliac fossa. Within the first twenty-four hours the pain becomes localized to the right side and of a dull constant nature. Localized tenderness in the right iliac fossa, or alternatively in the recto-vesical or Douglas's pouch, may be associated with restricted movement of the abdominal wall and rigidity in the right lower quadrant. The temperature may now be raised, the tongue furred and the breath offensive. During the next few days the clinical features vary, and the cases can be divided into three distinct groups:

1. Subsidence of the Attack.—The pain abates, the vomiting ceases, the temperature and pulse rate fall to normal, and the local signs gradually become less pronounced and finally disappear.

2. Appendicular Abscess.—The pain subsides, but the temperature remains up and may be irregular and swinging. Signs of toxæmia are accompanied by a dry brown tongue. Abdominal rigidity gradually disappears, and careful palpation will reveal a tender, localized mass in one of several situations—viz., (a) right iliac fossa, (b) pelvis, (c) above the iliac crest to the outer side of the cæcum. Fluctuation can sometimes be detected and leucocytosis is usual. If neglected, the abscess may burst through the abdominal wall, into the rectum, bladder or vagina, or into the general peritoneal cavity (especially in children), while spread may take place to the subphrenic region.

3. Spreading Peritonitis.—For a full description see p. 409.

Diagnosis.—Careful interrogation of the patient as to the previous history, mode of onset, character and radiation of the pain in the early stages, and the presence or absence of associated symptoms—e.g., cough, sweating, frequent or painful micturition—will often assist in excluding other conditions. The general appearance of the patient and the result of examination of the chest, urine and pelvis must all be taken into account. As the final decision will in many cases rest upon the evaluation of the local signs, the importance of combined abdominal and rectal examination in this connexion cannot be over-

emphasized. The conditions most likely to be confused with acute appendicitis are influenza, acute cholecystitis, pyelitis, leaking duodenal ulcer, salpingitis and ruptured ectopic gestation.

Prognosis.—Most cases subside after the first attack, but recurrence is the rule. It is impossible in the early stages to foretell what the outcome will be.

Treatment.—1. All cases seen within forty-eight hours of onset should be operated upon as soon as possible and the appendix removed.

2. All cases with spreading peritonitis should be operated upon at once, free drainage being provided and the appendix removed if readily accessible.

3. ~~Cases seen from the third day onwards~~ with definite localized signs must be placed under careful observation before a decision can be arrived at: (a) If indications are present that the attack is subsiding the patient should be kept in the Fowler position on rectal saline-glucose drip, aperients and sedatives avoided, and the pulse rate and temperature carefully recorded; appendicectomy should be performed within the next few weeks. (b) Cases which within the first few days present a localized mass should be operated upon without delay, abscesses drained, and the appendix removed, if this is possible without undue disturbance of adhesions. (c) From the end of the first week onwards the decision as to operation must be arrived at from the character of the mass in conjunction with any evidence of toxic absorption—*i.e.*, swinging temperature, sweating, flushed face, dirty tongue, etc. Should the mass be hard and well localized, while the pyrexia tends to settle and the patient's appetite is improving, operation can be deferred; on the other hand, a swinging temperature with evidence of toxic absorption and induration or oedema of the abdominal wall overlying the mass are indications for incision and drainage of the abscess. Attempts at removal of the appendix are to be deprecated as likely to lead to retroperitoneal cellulitis or fæcal fistula. In all probability the attempt at appendicectomy will need to be abandoned owing to the dense fibrous tissue encountered. W

Complications. — 1. *Abscess and cellulitis of the abdominal wall* after operation. The former is not uncommon when a gangrenous or perforated appendix has been removed and the wound closed; the temperature begins to rise at the end of the first week and tends to swing, while the area around the wound becomes puffy and tender. The introduction of sinus forceps often releases an astonishing amount of foul-smelling, blood-stained pus, which may contain small sloughs and pieces of partly digested catgut. Spreading cellulitis is less common, and usually occurs after operations involving division of muscle fibres in middle-aged obese patients; infection with anaerobic or aerobic organisms may spread widely, toxæmia is severe, and the outlook grave.

2. *Paralytic ileus*, (see p. 483).

3. *Pelvic or subphrenic abscess* (see p. 413).

4. *Pulmonary complications* — e.g., broncho-pneumonia, empyema, abscess of the lung and pulmonary collapse.

5. *Fæcal fistula* develops at the end of the first week after operations in which drainage has been employed. It is due to gangrene of part of the cæcum or ileum; fortunately spontaneous closure is the rule within a few weeks.

6. *Pylephlebitis* is rare, giving rise to a swinging temperature, repeated rigors and jaundice, and usually terminating fatally.

7. *Persistent sinus* usually indicates the presence of a foreign body, fæcal concretion, unabsorbable ligature, or a necrosed part of the appendix, but is due occasionally to some unusual factor — e.g., actinomycosis, tuberculosis or *Ps. pyocyanea* infection.

8. *Intestinal obstruction* from mechanical causes may occur at any interval after operation, being usually caused by a band or by kinking of the small intestine from adhesions.

9. *Ventral or incisional hernia* is usually the result of suppuration in the abdominal wall, an additional factor being the use of drainage tubes.

10. *Hæmatemesis* is the result of vascular infarction in the gastric omenta.

Chronic Appendicitis.—Mild and often unrecognized attacks of appendicitis frequently subside, leaving the appendix fibrosed, even to the extent of complete obliteration of its lumen; more commonly the contraction of localized areas of fibrosis leads to strictures, or kinking of the organ, with retention of fæcal contents. In true chronic appendicitis, since the peritoneum is scarcely ever affected, the pain, as would be expected, is ill-defined and not localized to the right iliac fossa. Apart from the increased liability to further acute attacks, this state of affairs may give rise to the following clinical pictures:

1. *Appendicular Colic.*—Attacks of discomfort or colicky pain in the abdomen, rarely more marked on the right side, may be associated with nausea and vomiting. They come on for no apparent cause and subside within a few hours.

2. *Appendicular Dyspepsia.*—The picture resembles that of an upper abdominal lesion—e.g., peptic ulcer or gall-bladder disease—and may be termed 'flatulent dyspepsia.' Localized tenderness may be present in the region of the appendix, palpation at this point often causing epigastric pain.

In any case of chronic appendicitis, skiagraphy after a barium meal may disclose a segmented appendix abnormally shaped, with delay in emptying, but kinks and failure to fill with barium must not be regarded as of diagnostic value. It is usually necessary to exclude the presence of disease of the right kidney and ureter, and of tuberculous glands in the ileo-cæcal angle before arriving at a diagnosis of chronic appendicitis. It should be remembered that appendicectomy is often performed unwisely in patients who complain of right-sided abdominal pain and in whom no lesion, gross or microscopic, can be detected in the organ after removal. Many patients so treated return subsequently with complaints of recurrence of pain in the original site, a diagnosis of 'adhesions' is made, and further operations are performed with similar sequelæ.

Treatment.—Appendicectomy should be performed and the opportunity taken to examine the other ab-

dominal organs, especially the gall-bladder, stomach and duodenum, owing to the frequency of associated lesions.

Actinomycosis.—The appendix and ileo-cæcal region are not infrequently affected, the disease spreading from the mucous coat to the peritonæum and leading to the formation of an indurated mass which adheres to the abdominal wall. Abscess formation is followed by the development of multiple sinuses, the discharge from which may sometimes contain granules of a yellow colour. Club formations, cocci and mycelium may be found in the discharge after suitable staining. Before sinuses appear the condition is usually mistaken for malignant disease, ileo-cæcal tuberculosis or simple appendicular abscess. The true nature of the infection only becomes apparent after examination of the discharge from the sinus which persists after operation.

Treatment.—Surgical measures are of little or no use, owing to the difficulty of eradicating the disease. Recently prepared tincture of iodine 10 to 30 minims in 2 ounces of fresh milk t.d.s. or large doses of potassium iodide by the mouth may be combined with irrigation of sinuses with 1 per cent. solution of copper sulphate. Although temporarily improved, the condition tends to spread slowly to the liver, and lardaceous disease often heralds the end.

Tuberculosis.—The appendix is often involved in ileo-cæcal tuberculosis, sometimes in tuberculous peritonitis, but very rarely alone.

Carcinoma.—Primary carcinoma is rare and of low malignancy, forming an indurated white or yellow nodule, usually near the tip of the appendix, with little tendency to infiltrate or invade lymphatic glands. Histologically two main varieties are seen: (a) Columnar-celled adeno-carcinoma in which mucoid degeneration may be extensive, or (b) spheroidal-celled alveolar, the cells arranged neatly in masses and often resembling basal-celled carcinoma. Some cases are discovered during operation for symptoms attributed to acute or chronic appendicitis, others during the course of various abdominal operations.

Carcinoid.—This tumour arises from cells of the autonomic nervous system and produces a mass rarely exceeding an almond in size which infiltrates locally but does not metastasize.

Mucocele.—A condition resulting from gradual complete obstruction of the lumen of the appendix. Rupture of a mucocele may give rise to masses of mucoid material in the peritoneal cavity similar to the condition found after rupture of a pseudo-mucinous ovarian cyst (*pseudo-myxoma peritonei*).

CHAPTER XXXIX

AFFECTIONS OF THE LIVER, BILIARY PASSAGES, PANCREAS AND SPLEEN

THE LIVER.

Displacements.—Hepatoptosis or downward displacement is usually seen in the subjects of general visceroptosis. If the liver can be replaced in its normal position it is termed *wandering*; if fixed in an abnormal position, *dislocated*.

Riedel's Lobe (Floating Lobe).—Part of the right lobe, by projecting from the lower border of the liver to the right side of the gall-bladder, may give rise to errors in diagnosis. It may be mistaken for an enlarged gall-bladder or an abdominal tumour; it is usually freely mobile from side to side and the kidney can be felt behind it.

Injuries.—Contusion, subcapsular rupture or laceration is usually the result of crushing or 'run-over' accidents and frequently associated with damage to thoracic or other abdominal viscera. The signs and symptoms have been dealt with on p. 406, but it should be remembered that slight jaundice is a not uncommon sequel to injuries of the liver and biliary passages.

Acute Suppurative Pylephlebitis.—This is a rare complication of infection in the territory drained by the portal vein, the primary focus being usually in

the appendix. Multiple small abscesses form in the liver, which is enlarged and congested. Repeated rigors with swinging temperature, enlargement and tenderness of the liver with slight jaundice, are the main features. Surgical interest is directed more to prophylaxis, by early diagnosis, chemotherapy and prompt operative treatment of intra-abdominal supuration, rather than to any direct attack on the established disease. When the primary focus is not obvious, the condition may be mistaken for a solitary abscess in the liver or a subphrenic collection.

Suppurative Cholangitis.—Is an occasional sequel to gall-stones in the common bile duct or to cholecystitis. The picture resembles that seen in suppurative pyelophlebitis, but jaundice appears earlier and is deeper. Here also the main problem is one of diagnosis, though free drainage of the common bile duct may be of some value.

Amoebic or Tropical Abscess (*Dysenteric Abscess*).—Is usually the result of infection by *Entamoeba histolytica*, though occasionally due to *Bact. dysenteriae*. It is not confined to the tropics, and, though often described as solitary, is nearly as often multiple. Males of twenty to thirty years, who are or have been sufferers from dysentery, are usually concerned. The onset of the abscess may be delayed for years in those who are living or who have lived abroad, but it is also found in those who have never crossed the sea; in the latter the infection is probably contracted from 'carriers' who, while harbouring the organism in the intestine, may never have suffered from dysentery.

Pathology.—The abscess wall is ragged and necrotic, containing thick yellowish or brownish-red inoffensive pus, which is usually sterile. Amoebæ can nearly always be found in tissue from the wall of the abscess cavity, but only seldom in the pus obtained at operation. In most cases the abscess is situated in the upper and posterior part of the right lobe. It is usually solitary (60 per cent.), may rupture into the lung, peritoneal cavity or externally, but in some cases it shrivels up without bursting.

Signs and Symptoms.—The onset is insidious, pain of a dull boring nature being felt in the right hypochondrium or referred to the point of the shoulder. Pyrexia, continuous or regularly intermittent as in malaria, malaise and profuse sweating are often associated with emaciation and an 'earthy' tint of the skin. Leucocytosis is usual, eosinophilia occasional. Fulness and tenderness in the hepatic region, liver dulness increased upwards, signs of compressed lung at the right base, with limitation of movement of the chest wall and friction sounds, may all be found. Skiagraphy often discloses elevation of the right side of the diaphragm with diminished movement.

Diagnosis.—(1) Skiagraphy is often of value. (2) Detection of amœbæ in the stools. (3) Therapeutic test: ten to twelve doses of 1 grain of emetine hydrochloride daily by intramuscular injection (or ampoules of bismuth emetine iodide by mouth) will give rapid relief in cases of amœbic hepatitis and considerable improvement in amœbic abscess. (4) Exploratory puncture with a large-bore needle under an anæsthetic. This should be followed, if pus is found, by immediate operation, the needle being left *in situ* as a guide.

Treatment.—Emetine should always be given a trial before other measures are contemplated, unless the abscess is on the point of bursting through the skin, in which case drainage should be used in combination with emetine. Aspiration and irrigation with quinine is often successful. Cannula drainage after exploratory puncture or open drainage as described under Subphrenic Abscess (p. 413) may be called for if these fail. Care must be taken to prevent secondary infection after operation. Emetine bismuth iodide capsules should be given during convalescence.

Syphilis.—In the tertiary stage, single or multiple gummata appear as rounded masses of considerable size, giving rise to the impression of one or more localized tumours which are therefore easily mistaken for neoplasms. Diffuse gummatous infiltration with enlargement of the liver occurs in inherited

syphilis, while syphilitic cirrhosis producing ascites is more often seen in the acquired disease.

Tuberculosis and *actinomycosis*, both rare, are usually secondary to disease elsewhere, and seldom diagnosed until exploration has been carried out.

Neoplasms.—Angioma and adenoma (hepatoma) are uncommon, but may reach a considerable size. If they cause pain—a rare event—excision is called for. Both primary carcinoma and sarcoma are rare; they are usually mistaken for gumma, abscess or cyst, since they give rise to soft necrotic growths. Secondary carcinoma and sarcoma appear as multiple nodules, which if superficial are often umbilicated; the liver may also be infiltrated by direct extension from the gall-bladder, stomach or colon.

Cysts.—1. Single cysts, though rare, are more common in females. • They are situated near the lower margin and may increase rapidly in size, forming a palpable swelling; diathermy excision or drainage should be performed.

2. Multiple cystic disease is very rare, the kidneys and pancreas being also usually affected.

3. Hydatid cysts (see p. 80).—In 60 per cent. of all cases of hydatid disease the liver is affected, a common site being to the right of the gall-bladder. There may be but one cyst; frequently there are others in the liver and elsewhere. Gradual enlargement of the cyst is the rule until one of three changes occurs: (a) Spontaneous death of the parasite, the cyst shrivelling and the contents becoming inspissated; (b) suppuration from bacterial infection; or (c) rupture into the pleural or peritoneal cavity from slight trauma or pressure necrosis of the wall.

Signs and Symptoms.—Twenty to forty years is the age at which these usually appear—rarely in childhood. Symptoms are often slight; sometimes the patient himself notices a tumour, this being followed by abdominal discomfort or actual pain from suppuration or peritonitis. Rupture of the cyst may cause severe collapse (hydatid shock), with subsequent peritonitis and urticaria, eosinophilia being a characteristic feature. Pressure symptoms—

e.g., jaundice or ascites—are rare. The liver may be enlarged upwards, compressing the right lung base, or the cyst may project from under the costal margin as a tense smooth mass, dull on percussion; rarely can any 'hydatid thrill' be elicited.

Diagnosis.—Skiagraphy is very useful, a good film sometimes showing even the daughter cysts, both in the liver and in other parts—*e.g.*, lung, muscles, bones. Eosinophilia is present in 75 per cent. of cases and is an indication of a parasitic disease, but of no more precise value. Casoni's intradermal test has proved of great diagnostic assistance, but requires careful technique.

Treatment.—Operation is indicated, an abdominal or thoracic approach being employed as thought desirable. The cyst being exposed, the wound should be packed with gauze or its edges sutured to the cyst wall; actual opening of the cyst should be deferred for ten days to avoid contamination of the pleura or peritoneum. The adventitious capsule is opened freely, the true cyst removed with forceps or gauze, the cavity obliterated with sutures or firmly packed and free drainage provided. Injection of formalin into the cyst ten days before operation, in sufficient amount to produce a 1 per cent. solution, is advisable.

THE BILIARY PASSAGES

Choledochus Cyst.—An unusual condition almost confined to females; the cystic dilatation of the upper part of the common bile duct may reach enormous proportions. The cause is presumed to be congenital, the passage from cyst to duodenum being free in most cases, while in others a stricture, valvular folds, or kinking of the duct is found. Symptoms appear either at puberty or later in life, a gradual onset of abdominal pain and jaundice being associated with a tumour, which may reach the size of a melon, in the right upper abdomen; variations in the size of the swelling and in the intensity of symptoms may be coincident. Anastomosis of the sac to stomach or duodenum has given the best results.

Torsion of the Gall-Bladder.—A rare condition associated with an abnormally mobile gall-bladder having its mesentery restricted to the cystic duct and ampulla. The twist is usually anti-clockwise and possibly results from colonic peristalsis. Diagnosis depends on the recognition of an enlarged gall-bladder within a few hours of the onset of acute upper abdominal pain and vomiting. Cholecystectomy is indicated.

Injuries.—Rupture of the gall-bladder or bile ducts is attended by severe shock, followed by jaundice (65 per cent.) and signs of low-grade peritonitis, most marked on the right side. This may prove fatal, or subside, leaving a localized collection of fluid in the right abdomen.

Cholecystitis.—Inflammation of the gall-bladder occurs as an occasional complication of general systemic infections such as typhoid fever, pneumonia, and influenza, etc., but in the vast majority of cases develops in association with gall-stones. In acute cases cultures from the bile produce a growth usually of *Bact. coli*, sometimes of *Bact. typhosus* or *paratyphosus*, anaerobic bacilli, and pyogenic cocci; in most of the chronic cases cultures are sterile.

Etiology.—The nature of the relationship of cholecystitis to gall-stones is the fundamental point which has yet to be decided. It has been maintained, largely on experimental grounds, that many cases of cholecystitis are due to organisms (chiefly streptococci) which reach the gall-bladder wall through the blood stream from distant foci of infection—*e.g.*, teeth, tonsils, appendix, and female pelvis. The resultant inflammation induces changes in the bile which determine the deposition of cholesterin, bile pigments and bile salts in the form of calculi. In opposition to this view it is urged that gall-stones are frequently found without any evidence of preceding cholecystitis, and are in many if not most cases due to metabolic disturbances affecting the bile; evidence is accumulating in favour of the view that gall-stones are attributable to changes in the bile salts: cholesterin ratio, due either to diminished excretion of the former by the liver as the result of hepatic disease, or to their increased

absorption through the gall-bladder wall, possibly from inflammatory changes. According to this view, cholecystitis is in a majority of cases the result, not the cause, of gall-stones. Stagnation of bile containing minute concretions is predisposed to by mechanical factors in and around the cystic duct—*e.g.*, kinking, narrowing, valvular obstructions and adhesions. In course of time infection is superadded, but whether hæmatogenous or lymphatic in origin, or by ascent from the duodenum, is still a matter of doubt.

Pathology.—All grades of inflammatory reaction, from a mild catarrh to an acute gangrenous process, are to be found. Suppuration may lead to empyema of the gall-bladder, ulceration and perforation, the latter seldom resulting in spreading peritonitis owing to preformed dense adhesions, but rather to a localized abscess or a fistula into colon, duodenum or externally. Chronic catarrh is said to be responsible for the *strawberry gall-bladder*, in which the mucous membrane contains deposits of lipoids and cholesterin, and also for the *papillomatous gall-bladder* with its thickened irregular lining. In long-standing cholecystitis the gall-bladder wall may become thickened and fibroid and the cavity almost obliterated, while hour-glass deformity is not unknown; dense adhesions to the duodenum may result in pyloric obstruction.

Signs and Symptoms.—The maximum incidence is in the fifth decade, but no age is exempt. Abdominal discomfort, aggravated by inspiration, is felt mainly above the umbilicus; pyrexia, nausea and vomiting are also usual features. Within a few hours the pain becomes concentrated in the right hypochondrium, the signs of local peritonitis assert themselves, and slight or moderate jaundice from associated catarrh of the ducts is not infrequent. As the attack subsides in the course of a few days—the usual event—the tender distended gall-bladder may become palpable. In gangrenous cholecystitis pain is more acute, spreading peritonitis rapidly sets in, and toxæmia is severe, often associated with delirium.

Diagnosis.—During the first few hours it may be impossible to distinguish the condition from acute

appendicitis, acute pancreatitis, perforated or leaking duodenal ulcer, intestinal obstruction or pneumonia, and careful observation is imperative. Localization

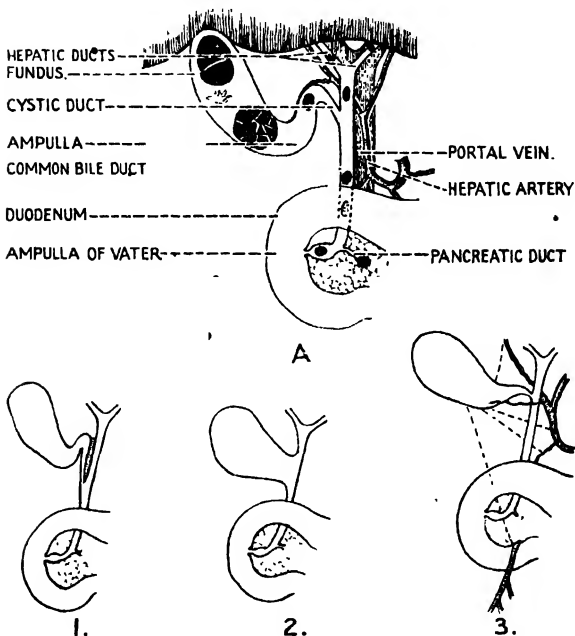


FIG. 50.

A, The biliary passages, indicating sites where gall-stones may be present; 1, 2 and 3, important abnormalities of the biliary apparatus; in 3 the dotted lines indicate sites of origin of aberrant cystic arteries.

of the pain and physical signs to the right hypochondrium will usually serve to clear up any doubt.

Treatment.—With the exception of gangrenous, cholecystitis, for which removal (cholecystectomy)

or drainage of the gall-bladder (cholecystotomy) is urgently required, expectant treatment suffices in nearly all cases. Rest in bed in the Fowler position, ample fluids, local application of heat, with sedatives to relieve pain, are the main necessities. Suppuration, as indicated by irregular pyrexia and protracted local signs, occasionally calls for drainage.

Thorough investigation, not only of the gall-bladder, but of other abdominal viscera, should be carried out after the attack has subsided; cholecystography combined with examination by means of a barium meal will disclose the functional condition of the gall-bladder, and may reveal gall-stones or associated lesions such as duodenal ulcer or chronic appendicitis. By duodenal intubation bile may sometimes be withdrawn from the gall-bladder and cultivation of the fluid reveal the persistence of the infection. Cholecystectomy is indicated in all cases when gall-stones are present or when there is strong cholecystographic evidence of a diseased gall-bladder.

Cholelithiasis.—Gall-stones may occur in any part of the biliary passages, but are found most frequently in the gall-bladder.

Etiology.—The infective and metabolic views have already been outlined (see p. 497). Analysis of gall-stones usually reveals a nucleus of organic material, bacterial, epithelial or mucoid, and the evidence at present available suggests that both infective and metabolic factors play important parts in the production of biliary calculi. It may be added that the view held previously, which sought to indict pregnancy or certain diets—*e.g.*, excess of meat—as causative factors, has been negated by recent research demonstrating an equal incidence of gall-stones in those who have not borne children, and by failure to disclose any abnormality of cholesterin content in the bile following a diet rich in meat or fat. Two facts stand out beyond cavil—*viz.*, gall-stones are closely associated with obesity and femininity, hence the dictum that they occur in the ‘fair, fat and forty.’

Varieties.—The majority of gall-stones consist of a mixture of cholesterin and bile pigments (or their

calcium salts), some of bile pigments and salts mainly in combination with calcium, and a few of pure cholesterol. Soft irregular masses of inspissated pigment, barely justifying the name stone and sometimes referred to as biliary mud, putty or sand, may be found in the obstructed common bile duct, though also met with in the gall-bladder. Solitary stones are usually oval and rough, the multiple variety often faceted and smooth; there may be several thousand minute concretions, or one or more stones of such a size as to cause obstruction to the lower ileum.

Results.—(1) Inflammation (see Cholecystitis). (2) Obstruction: A calculus may become impacted in the neck of the gall-bladder, in its ampulla or pelvis (Hartmann's pouch), or in the cystic duct. Impaction is usually followed by infection of the contents of the gall-bladder. Similar changes may ensue in the main hepatic and common bile ducts, from the lodgment of calculi which have passed through the cystic duct or have developed *in situ*. Calculi of large size, either in the gall-bladder or common bile duct, may by pressure necrosis and ulceration find their way to the bowel *via* a fistulous opening. It sometimes happens in obstruction of the gall-bladder that the contents are sterile, the viscus distending with a colourless mucoid fluid (hydrops): it may reach a large size.

Signs and Symptoms.—The incidence is considerably greater in females. Obesity, chronic constipation, overeating, and sedentary habits are frequently associated features. The following clinical groups are distinguishable:

Group 1: Flatulent Dyspepsia.—The symptoms are often of long standing: discomfort after meals, flatulence, heart-burn, palpitation, nausea, bilious eructations and constipation. Definite attacks of epigastric pain, often worse after food and relieved by vomiting, may recur at intervals of a few days; in contrast to gastric and duodenal ulceration, the attacks are seldom of more than a few hours' duration. The appetite is usually unimpaired, but there may be distaste for fatty foods owing to the discomfort

consequent on their ingestion. Slight irregular fever and a feeling of chilliness are sometimes experienced.

Group 2: Cholecystitis in one of its various forms may be the first indication of gall-stones.

Group 3: Biliary Colic.—The patient is seized with agonizing pain in the epigastrium or right hypochondrium, accompanied by collapse, sweating, vomiting and restlessness. Radiation of the pain, mainly to the back and right shoulder, but also to the chest or arm, is characteristic. Extreme tenderness in the right upper quadrant of the abdomen is sometimes found in conjunction with rigidity. As the attack subsides, usually within a few minutes or hours, the abdomen becomes softer and tenderness is localized to the gall-bladder region. Pressure beneath the costal margin during deep inspiration may cause the patient to catch his breath (Murphy's sign or Naunyn's test). Tenderness in the epigastrium may also be present soon after the attack has subsided, while the gall-bladder may be palpable as a smooth pear-shaped tumour, moving on respiration and pointing towards the right iliac fossa or the umbilicus.

Group 4: Obstructive Jaundice.—In this group the prominent feature is the persistence of jaundice, often over a period of several weeks. Irregular pyrexia, sometimes with rigors (Charcot's intermittent hepatic fever), marked emaciation and clay-coloured offensive stools often complete the picture. Remissions or intermissions of jaundice are the rule, the patient's condition progressively deteriorating.

Groups 1 and 2 account for the great majority of gall-stone cases, classical biliary colic being relatively uncommon, obstructive jaundice comparatively rare. Taking all cases into consideration, jaundice in any form occurs in approximately one-fifth only, and even in cases with stones in the common bile duct the incidence is not more than one in three.

Finally, it must be noted that gall-stones may lie latent for long periods of years, not infrequently being found during the course of abdominal operations or post-mortem examinations, without any previous complaint pointing to biliary disease.

Diagnosis.—From the foregoing it is obvious that the problem is entirely different in the various groups. Cases in Group 1 need thorough investigation before a diagnosis is arrived at; gastric and duodenal ulcer, malignant disease of the stomach, bowel or peritoneum, etc., must be excluded. Skiagraphy is of considerable value, for whereas X-rays alone disclose only 10 per cent. of stones in the form of a characteristic ring shadow with occasional lamination, etc., oral or intravenous cholecystography will be of assistance in 90 per cent. of cases. Not only may calculi be revealed as negative shadows in the gall-bladder, but the functional capacity of the latter can be roughly gauged; delay in appearance, variations in intensity, undue persistence or total absence of the gall-bladder shadow may be found. An opaque meal or enema in conjunction with cholecystography may help to elucidate irregularities in outline of the gall-bladder and demonstrate the presence of associated lesions—*e.g.*, duodenal ulcer or chronic appendicitis.

Cases in Group 2 have been dealt with under Cholecystitis. Biliary colic is liable during the first few hours to be confused with other forms of colic (intestinal, renal), perforation of gastric or duodenal ulcers, and acute pancreatitis; the radiation of the pain and localization of the maximum intensity of physical signs to the right hypochondrium are helpful at this stage. When tenderness develops in the gall-bladder region or the distended viscus becomes palpable, the diagnosis is usually obvious. To distinguish Group 4 cases from other forms of jaundice, obstructive or hæmolytic—*e.g.*, pancreatitis, carcinoma of pancreas, catarrhal jaundice, etc.—certain features must be noted carefully, particularly the variations in intensity of jaundice, the association with attacks of colic, and the absence of a distended palpable gall-bladder. The van den Bergh reaction may help by giving an immediate direct reaction, as opposed to a delayed direct reaction in jaundice of hæmolytic origin.

Treatment.—Once established that gall-stones are present and the cause of symptoms, operation should be advised, provided it is not contra-indicated by

the general condition of the patient. Special pre-operative measures are desirable in jaundiced patients and those with evidence of hepatic disease; delayed clotting time calls for intramuscular injections of 1 c.c. of vitamin K on three successive days before and after operation, supplemented if required by blood transfusion. Liberal amounts of glucose by mouth or continuous intravenous injection of a 5 per cent. solution should never be omitted. At operation the gall-bladder is exposed, the presence of stones confirmed, and the cystic, hepatic and common bile ducts carefully palpated. Should stones be present in the common or hepatic ducts, the former is opened (choledochotomy) and the main ducts cleared until a probe can be passed downwards into the duodenum and upwards to the portal fissure. Drainage of the common duct is provided for by a T-tube or one with flanged end, brought out through a stab incision below the ribs to the outer side of the ascending colon. When the common duct is greatly distended, contains 'white' bile, or when there is evidence of hepatic insufficiency, there should be an attempt made to 'decompress' the duct gradually, much as is carried out in long-standing obstruction of the urinary bladder. Cholecystectomy is now proceeded with unless the patient's condition renders it inadvisable, when it can be postponed for some weeks. Diathermy is often helpful in cholecystectomy to minimize hæmorrhage from the liver and to obviate drainage of the abdomen in a majority of cases. Cholecystectomy is an operation usually requiring considerable experience and skill in its successful performance for the following reasons: (1) The dense adhesions which may be encountered, (2) anomalies of both cystic duct and artery may be met with, (3) obesity of the patient. Taking these facts into account, and in spite of the manifest advantages of cholecystectomy, the tyro would be well advised to open the gall-bladder, remove stones and drain the viscus, unless conditions are ideal for cholecystectomy.

Recurrence of stones in the ducts follows cholecystectomy in 2 to 3 per cent. of cases; after cholecyst-

otomy the recurrence rate is 20 per cent., and there is with the latter the added danger that carcinoma of the gall-bladder may supervene. Choledochotomy carries with it a considerable mortality from associated hepatic and myocardial disease.

Biliary Fistulæ.—These may be external or internal:

1. *External.*—May be spontaneous or traumatic in origin. The former results from rupture of an empyema of the gall-bladder when the cystic duct is obstructed; it may open close to the umbilicus, near the costal margin, or in the right iliac fossa or loin. The traumatic follows operations; it may be *mucoïd* or *biliary*, depending upon whether the cystic or common bile duct is obstructed by overlooked calculi, injuries to the ducts inducing strictures, by pancreatitis or malignant growth.

Treatment.—Operative interference should be postponed for eight to twelve weeks in the hope of spontaneous closure. At operation the cause must be determined and if possible removed; reconstruction of the ducts or anastomosis of the gall-bladder to stomach or intestine may be called for.

2. *Internal.*—The duodenum, colon or stomach is usually involved, the condition being unsuspected, owing to absence of specific symptoms, until operation on the gall-bladder.

Carcinoma of Gall-Bladder.—In at least 30 per cent. of cases gall-stones are present, or have been removed previously by cholecystotomy. The growth may form a localized nodular tumour, or lead to diffuse infiltration of the viscus indistinguishable to the naked eye from chronic cholecystitis. The liver is soon infiltrated by direct spread; the colon, duodenum and omentum are often adherent, and the glands in the portal fissure eventually become involved. Intractable pain in the gall-bladder region associated with emaciation, superimposed on a long-standing history suggestive of gall-stones, should arouse suspicion, which may be confirmed by the discovery of a stony-hard nodular tumour. Free excision of the gall-bladder and adjacent liver is indicated, once metastases have been excluded.

Carcinoma of Bile Ducts.—This usually occurs in middle-aged men, at one or other extremity of the common bile duct, as a localized hard nodule which may be mistaken for a calculus. Steadily increasing painless jaundice of obstructive type, emaciation, smooth moderate enlargement of the liver and a distended gall-bladder are the main features. Cholecyst-enterostomy is usually the wisest procedure, but in early cases successful excision of the growth, with reconstruction of the duct, has been performed.

THE PANCREAS

Acute Pancreatitis.—A disease of grave import, the cause of which is not too clearly understood. The frequent association with disease of the biliary passages is undisputed; it is suggested by some that infection spreads up the pancreatic duct, or alternatively that, owing to obstruction at the ampulla of Vater, bile regurgitates into the pancreas and activates the pancreatic ferments within the gland. Others maintain that infection takes place via the lymphatics or blood stream (as is presumably the case in mumps, influenza, etc.).

Pathology.—There are two main degrees—viz., (1) acute œdema, (2) acute necrosis. Characteristic features are the *hæmorrhagic exudate* which infiltrates the pancreas and surrounding cellular tissue, and escapes into the peritoneal cavity, and the *fat necrosis* in which small, opaque, firm, white scattered areas appear in the mesentery, omentum, retroperitoneal tissue, and even the abdominal wall, being usually most marked near the pancreas. Abscesses may form in the gland, or larger or smaller areas become gangrenous in the course of two to three days. Peritonitis, which is usually most marked in, and may be confined to, the lesser sac, often follows; the effusion may be hæmorrhagic or bile-stained. Pancreatitis may complicate typhoid fever, mumps and influenza; after a period of seven to ten days a pancreatic abscess sometimes develops in the lesser

Signs and Symptoms.—The onset is usually sudden with severe epigastric pain going through to the back, profound collapse and vomiting. The sufferers are frequently middle-aged, sometimes obese and of alcoholic habits (25 per cent.), and usually males (2:1) with a history of chronic dyspepsia. Epigastric tenderness and rigidity, cyanosis, occasionally slight jaundice (20 per cent.), subnormal temperature and a small thready pulse are the usual features. Within twenty-four hours an ill-defined mass may be felt in the epigastrium or left lumbar region, and later a greenish-yellow oedematous area may appear in the loin or near the umbilicus. Many cases are fatal within a few days from toxæmia or septic peritonitis, but if not the symptoms may abate and a mass develop in the pancreatic region, with raised temperature and pulse rate. Pancreatic insufficiency is liable to follow recovery from the acute stage, and is manifested by wasting, marked weakness, and uncontrollable vomiting which may lead to a fatal result. True diabetes may also be associated with it.

Diagnosis.—Intestinal obstruction, perforated peptic ulcer and biliary colic may be simulated. In the early hours Loewe's adrenalin mydriasis test may assist; 5 minims of 1:1,000 adrenalin solution are dropped into one conjunctival sac and repeated in five minutes' time; if positive the pupil dilates, often eccentrically, within half an hour. This test is often negative in indisputable pancreatitis. The urinary diastase may be considerably increased from the normal 10 to 30 units up to 1,500 units or more, and glycosuria is often present.

Treatment.—Laparotomy with drainage of the pancreatic area should be combined, unless the patient's condition is desperate, with drainage of the biliary passages; cholecystotomy, with removal of any stones present, is usually preferable to choledochotomy. Since streptococci are said to be the infective factor, it would be logical to employ chemotherapy.

Chronic Pancreatitis.—Co-existent cholelithiasis or cholecystitis is the rule both in chronic and acute pancreatitis, but occasionally they occur in association

with obstructions in the common duct, or with diabetes in the absence of gall-stone disease. The whole gland or the head alone may be involved, fibrosis—interstitial or interacinous—compressing the glandular elements and leading to increase in size of the pancreas. This is markedly indurated and sometimes irregular in contour, thus closely resembling malignant disease. Pancreatic insufficiency often ensues, and may sometimes be detected by the following methods: (1) Examination of the *faeces* for signs of incomplete digestion of proteins and fats—viz., excess of muscle nuclei, fatty acid crystals or fat droplets, etc. (2) Examination of the urine for glycosuria, increased diastase, and in advanced cases diminished sugar tolerance. (3) Loewe's adrenalin mydriasis test is useful when positive, but is unreliable.

Signs and Symptoms.—(1) In many cases the clinical features are obscured by those of cholelithiasis, the diseased pancreas being found only at operation. (2) On occasion, steadily increasing jaundice, emaciation and a palpable distended gall-bladder lead to laparotomy and cholecyst-enterostomy for what is thought to be carcinoma of the pancreas; jaundice is relieved, the patient regains health, and only after a considerable number of months is it realized that the indurated mass felt at operation was in fact due to pancreatitis. (3) The onset may be subacute, with features resembling, on a minor scale, those of acute pancreatitis; these tend to subside, leaving indications of pancreatic insufficiency. (4) There still remains a group of patients suffering from chronic ill-health with vague dyspeptic symptoms, unaccountable attacks of vomiting, occasional offensive diarrhoea, emaciation and sallow appearance. In them investigation fails to reveal any evidence of biliary disease, but signs of pancreatic deficiency are forthcoming.

In any of these types the pancreas may be palpable and tender, while skiagrams sometimes demonstrate that it is enlarged.

Treatment.—Operation is indicated, both to confirm the diagnosis and to deal with associated biliary

disease. Cholecyst-enterostomy is of value in jaundiced patients, while cholecystostomy or choledochostomy is sometimes recommended when no extra-pancreatic lesion is discoverable.

Pancreatic Cysts.—These are rare and may be divided into true or false (pseudo-cysts).

1. *True cysts* are usually found in the tail of the gland and comprise several types: (a) Retention; may be associated with chronic pancreatitis; (b) cyst-adenoma; (c) congenital cystic disease; (d) hydatids; (e) dermoid.

2. *Pseudo-cysts* may be intra- or retroperitoneal, and are due either to trauma or to pancreatitis.

The fluid present in these cysts may be clear, brown or blood-stained, alkaline, and generally contains one or more pancreatic ferments. As the cyst increases in size it bulges forwards and may present between (a) stomach and transverse colon, (b) stomach and liver, or (c) the layers of the transverse mesocolon, appearing below the colon.

Signs and Symptoms.—Most cases are seen in adults. In true cysts pressure symptoms are usually present: epigastric discomfort, nausea, vomiting, jaundice or signs of intestinal obstruction. Pain indicates inflammatory changes. In pseudo-cysts interrogation of the patient may elicit a history of preceding trauma, followed by acute pain and collapse which subsided; within a variable period of days, weeks, or months pain has recurred and a palpable swelling developed.

Diagnosis.—This must be made on the physical signs taken in conjunction with skiagrams; an opaque meal or enema, and a pyelogram, will often disclose displacement of stomach, colon or kidney. Pancreatic function is frequently normal, but examination of urine and faeces should not be omitted.

Treatment.—Operation is strongly indicated owing to the certainty of progressive increase in size of the cyst. Complete excision is ideal but is seldom practicable, owing to dense vascular adhesions to vital structures—*e.g.*, aorta, portal vein, etc. Drainage is the alternative, special care being needed to prevent the cyst fluid entering the peritoneal cavity;

if possible, the cyst should be opened and the wall sewn to the abdominal parietes (marsupialization). The discharge is often abundant and tends to digest the abdominal wound, which should be painted with 2 per cent. hydrochloric acid or egg albumen, the patient being kept on a carbohydrate-free diet with copious fats and small doses of sodium bicarbonate.

Adenoma of the islet tissue may induce hyperinsulinism. Surgical removal may be feasible.

Carcinoma.—This may arise from the acini (commonest), ducts or islet tissue, and occurs in patients of forty to seventy years, more frequently males. The head of the pancreas, the usual situation, becomes stony hard, irregular and enlarged; the common bile duct eventually becomes obstructed, less often the portal vein and duodenum.

Signs and Symptoms.—Obstructive symptoms predominate. Painless progressive jaundice, with intense itching and mental depression, are usually associated with dyspepsia. Loss of appetite, wasting, ascites and pyloric obstruction are later manifestations. The deep bronze colour of the skin may be a striking feature; the liver is enlarged and smooth, the lower edge usually palpable—often a hand's-breadth or more below the costal margin—and the fundus of the distended gall-bladder can sometimes be felt.

Diagnosis.—Steadily increasing painless jaundice of an obstructive type should always arouse suspicion. Courvoisier's law states that 'when the common duct is obstructed by a stone dilatation of the gall-bladder is rare; when the duct is obstructed from other causes dilatation is common.' It merely remains to add that carcinoma of the pancreas is an important 'other cause,' but that the gall-bladder is nevertheless by no means always palpable.

Treatment.—Excision of localized growths confined to the tail or body of the gland has occasionally been successful. More often the condition is diffuse, surrounds the duodenal wall and the common duct, and is irremovable. Cholecyst-jejunostomy or cholecyst-gastrostomy is usually indicated for the relief of jaundice.

Pancreatic Calculus.—This, though rare, occurs in association with pancreatitis, either in the form of 'sand,' or as an oval or branched stone composed of carbonate and phosphate of calcium or magnesium, opaque to X-rays. It may give rise to attacks of colic referred to the left costal margin and shoulder. Removal followed by drainage is indicated.

THE SPLEEN

Rupture.—May be associated with injuries to thoracic or to other abdominal viscera in run-over accidents, though it may be the sole injury resulting from a blow or fall; 'spontaneous' rupture has frequently been recorded when the organ is enlarged and diseased—*e.g.*, in malaria, typhoid fever, splenic infarct.

Diagnosis.—This is often impossible without operation, but is suggested by signs of internal hæmorrhage in conjunction with tenderness, rigidity, and dulness in the splenic region and left shoulder-tip pain.

Treatment.—Suspicion of splenic rupture calls for immediate laparotomy unless the patient is moribund, when general measures to combat shock should be instituted. Extirpation is preferable to attempts at suture or packing, and should be followed by blood transfusion.

Movable Spleen (*Prolapse, Wandering or Ectopic Spleen*).—Moderate abnormal mobility of a spleen of normal size may be found in visceroptosis, but enlargement of the organ is sometimes associated with extreme mobility, the spleen lying in the pelvis or lower abdomen with a pedicle several inches in length. Dragging pain and indigestion may result and *torsion* is not infrequent; in the latter instance acute abdominal pain and vomiting are followed by signs of peritoneal irritation.

Loss of normal splenic dulness and palpation of the characteristic notched border of the tumour may assist in diagnosis, but mistakes are often made.

Treatment.—If enlarged or causing symptoms, the spleen should be removed. Splenopexy is not to be recommended.

Gunshot Wounds.—Concomitant injuries to the left kidney, colon, diaphragm and pleura obscure the damage to the spleen, the diagnosis being made only at operation. Splenectomy is often advisable.

Splenomegaly.

No attempt will be made to enumerate the causes of enlargement of the spleen, but certain conditions amenable to surgical treatment will be outlined briefly.

Malarial Spleen.—Chronic malaria frequently leads to considerable enlargement, while many cases of idiopathic splenomegaly found in certain countries—*e.g.*, China—may be caused by unrecognized malarial infection. Abnormal mobility, prolapse and torsion of the organ are liable to occur, while rupture may follow slight injury. Marked anæmia is often present.

Treatment.—Splenectomy is indicated when splenomegaly and excessive mobility of the organ coexist, the operative mortality being low. In the presence of adhesions the death rate from operation is prohibitive.

Splenic Anæmia.—A chronic disease of unknown origin affecting young adults, the main features of which are: (a) splenomegaly, (b) secondary anæmia with absence of erythroblasts, (c) leucopenia with absence of myelocytes, and (d) diminished or normal fragility of the red cells. Cirrhosis of the liver with ascites develops later in some cases (Banti's syndrome). Two forms of splenic anæmia are recognized:

1. *Thrombocytopenic.*—Hæmorrhages are prominent, the bleeding time prolonged, retraction of clot poor, and thrombosis rare after splenectomy. Blood platelet counts are low before operation, rise temporarily after it, and then fall to normal.

2. *Thrombocythæmic.*—Hæmorrhages are infrequent, while after splenectomy thrombosis is common and often fatal. Blood platelet counts are normal before operation, rising to a persistently high level after it.

Treatment.—Splenectomy cures most cases in the early stages, and results in marked improvement both in the anæmia and the cirrhotic state of the liver

in advanced cases. Perisplenic adhesions, mainly to the diaphragm, increase as the spleen enlarges and render operation more hazardous. X-ray therapy may be of value in reducing the size of the spleen before operation. Thrombosis spreading to the portal vein is responsible for most of the deaths after splenectomy, which carries a mortality of 10 per cent.

Chronic Hæmolytic Anæmia (*Acholuric or Hæmolytic Jaundice*).—Two forms of this occur:

1. *Congenital or Familial*.—Splenomegaly and jaundice commence soon after birth, usually in members of certain families, and continue throughout life with periodic attacks of epigastric pain, fever and exacerbations of jaundice. Gall-stones may complicate the picture. Bilirubin is absent from the urine, which, however, contains an excess of urobilin; there is an absence of itching, but the main diagnostic feature is increased fragility of the red blood cells.

2. *Acquired*.—A more rapid and graver form in which gall-stones are particularly prone to develop, the disease being thought to be of infective origin.

Splenectomy is of great benefit in both types, and should be combined with removal of gall-stones if present. The mortality from operation is comparatively low (5 per cent.).

Essential Thrombocytopenia (*Purpura Hæmorrhagica*).—This form of the hæmorrhagic diathesis is most common in young women; the splenomegaly is usually moderate. Repeated hæmorrhages occur, from mucous membranes, the genito-urinary tract and subcutaneously. The blood changes are (a) low platelet count, (b) increased bleeding time, (c) normal clotting time, with slow retraction of clot. Increased permeability of the capillary endothelium appears to be the essential defect.

Some cases run an acute course, but nevertheless tend to recover spontaneously; they do badly after splenectomy. Other cases tend to relapse and are more chronic; in these splenectomy produces good results. Hæmorrhages usually cease, the blood platelets rise permanently, and clotting becomes more normal. The operative mortality is relatively low (10 per

cent.), as the spleen is of moderate size and free from adhesions.

Myelocytic Leukæmia (*Spleno-Medullary or Myelogenous Leukæmia*).—A disease characterized by excessive production of white blood cells and the presence of myelocytes in the circulating blood. Splenectomy is of doubtful value, but has been carried out, following pre-operative application of radium to the spleen, with a mortality of under 5 per cent.

Splenic Abscess.—This may arise from various causes: (a) General infections—*e.g.*, typhoid fever or pneumonia, (b) pyæmia, (c) injuries with resultant hæmatoma, (d) amœbic dysentery, (e) secondary infection of an infarct or hydatid cyst, and (f) tuberculosis, actinomycosis and gumma. The abscess may burst into the peritoneal cavity, stomach, colon, or through the diaphragm, forming an empyema. Drainage is necessary, the operation being carried out in two stages when no adhesions exist between the spleen and abdominal wall.

Syphilis.—Gumma may reach a considerable size and fail to respond to the usual remedies. Even when associated with similar lesions in the liver splenectomy may be advisable, as the response to specific treatment is enhanced by the operation.

Actinomycosis is rare and associated with similar lesions elsewhere.

Cysts of the Spleen.—(1) Hydatid cyst is rare and usually solitary. A large mobile tumour appears, causing pressure symptoms; suppuration or calcification sometimes supervenes. (2) Blood cyst follows trauma. (3) Serous or lymphatic, and dermoid cysts have been described.

Cavernous Angioma has occasionally been successfully treated by splenectomy.

Sarcoma is of rapid growth and leads to a hard irregular tumour with early metastases and marked emaciation; eosinophilia and leucocytosis have been noted. Splenectomy has produced some surprisingly good results.

Splenectomy.—The indications for this operation

are: (1) Injuries—(a) penetrating wounds, (b) rupture. (2) Torsion of the spleen. (3) Abnormal mobility causing symptoms, especially if associated with hypertrophy. (4) Splenic anæmia, chronic hæmolytic anæmia and essential thrombocytopenia. (5) Some cases of malarial spleen. (6) Kala-azar, Mediterranean and Egyptian splenomegaly. (7) Primary sarcoma and cavernous angioma. (8) Cysts—hydatid, blood, serous and dermoid. (9) Certain types of cirrhosis of the liver associated with splenomegaly (Banti's syndrome).

CHAPTER XL

AFFECTIONS OF THE RECTUM AND ANAL CANAL

Malformations.—Embryology and comparative anatomy supply the explanation for the diversity of congenital abnormalities met with in the lower end of the alimentary canal. The rectum and anal canal are derived from three developmental structures: (a) hind-gut, (b) post-allantoic gut, (c) proctodæum. The junction of (a) and (b) is at the level of the peritoneal reflexion from the rectum to the bladder or vagina, that of (b) and (c) opposite the anal sinuses. In lower animals the hind-gut opens into the cloaca, which is represented in man by the trigone of the bladder and the urethra. When malformed, the hind-gut in man may open at any point from the vesical trigone to the under surface of the frænum of the penis, in woman into the vagina or vulva. Alternatively it may end blindly at the back of the prostate or posterior vaginal fornix, with or without an intervening fibrous cord. The hind- and post-allantoic gut may join normally while the lower end of the latter ends blindly some distance from the perineum, or is separated by a thin membrane only from the proctodæum—*imperforate anus*.

As a rule the better developed the proctodæum the nearer the rectum to the perineum, but many exceptions to this are found. When the gut ends

blindly, vomiting, abdominal distension and wasting appear soon after birth; when abnormal apertures exist, the outlook depends upon the size of the opening, and the child may survive for years without serious inconvenience.

Treatment—(1) If, when the child strains, bulging of the rectum can be detected with a finger in the proctodæum, free incision of the intervening membrane is called for, followed by frequent dilatation. (2) Left inguinal colostomy is the operation of choice in all other cases of obstruction. Attempts to construct a perineal anus, in so young a child with intestinal obstruction, are to be deprecated; if colostomy is survived, plastic operations should be postponed for several years. (3) When an opening exists into the vulva, it may be large enough to allow free passage of fæces with some sphincteric control; it is then best left alone. If small, an attempt should be made to provide a perineal anus. In the male the opening is usually small and colostomy or a perineal operation advisable.

Injuries and Foreign Bodies.—Falls on spikes may penetrate the rectal wall and set up peritonitis. Many fatalities have been recorded in U.S.A., etc., from introducing the nozzle of a compressed air apparatus. Division of the sphincters back to the coccyx affords good access to most wounds, but laparotomy may be required. Large and often bizarre foreign bodies may be introduced and their removal may demand abdominal section to permit their manual expression *per viam naturalem*.

Congenital Post-Anal Sinus (Pilonidal Sinus).—Anal or pilonidal sinus probably arises as a result of bursting and discharge of a small post-anal dermoid cyst followed by secondary infection. Radical extirpation of the whole track is necessary to prevent recurrence.

Proctitis.—When inflamed, the rectal mucous membrane becomes oedematous and velvety in appearance, with adherent shreds of muco-pus and fibrin. In severe cases multiple ulcers, stricture and perirectal suppuration may develop. Tenesmus,

with frequent passage of mucus, muco-pus and blood, rectal pain and pruritus ani, are the rule; abdominal discomfort and emaciation from associated colitis may be features. Reflex urinary symptoms are frequent.

Varieties—1. *Pyogenic*.—Predisposing factors are: (a) injury or foreign bodies, (b) impacted fæces, (c) threadworms, (d) errors in technique during injections for piles, and (e) operations on the rectum. In many the proctitis is part of a generalized infection of the large bowel, which may be catarrhal (mucous) or ulcerative, the treatment being on similar lines. When due to threadworms, rectal irrigations with salt solution, and santonin 3 grains, calomel 1 grain internally for three successive nights, will effect a cure.

2. *Gonococcal*.—Uncommon and more frequent in women, but may be found in young men as the result of sodomy. Rectal tenesmus and pain are severe, ulceration and rectal stricture liable to follow. Irrigations with boracic lotion or protargol may be combined with sulphonamide therapy.

3. *Dysenteric*.—May be of the bacillary or amœbic type and usually part of a generalized colitis. Extensive ulceration with undermining of the mucous membrane is the rule, and involvement of the muscular coat may lead to stricture. The bacillary type may respond to antidysenteric serum, but the amœbic is often resistant to emetine, which, however, should be used in combination with irrigations of 1 per cent. quinine sulphate.

4. *Post-Irradiative*.—This is being met with in increasing numbers following the use of radium applicators in the treatment of carcinoma of the cervix and uterine diseases. It leads to massive induration of the anterior rectal wall, and may be mistaken for a neoplasm; it is occasionally followed by ulceration and stenosis. The onset is usually delayed for many months after radium treatment has been discontinued; pain may be severe and colostomy sometimes called for.

5. *Tuberculous*.—Occurs in association with pul-

monary or intestinal lesions, and leads to ulceration, ischio-rectal abscess and fistulæ.

6. *Syphilitic or Gummatous*.—Rare, but frequently followed by stricture.

7. *Bilharzial*.—Commonly seen in Egypt and the East, especially in children; bladder lesions may coexist. The rectal mucosa is red, swollen and spongy, the spiked ova being identified microscopically. Anæmia may be marked, but the condition responds to intravenous injections of antimony, especially after removal from the endemic source of infection.

8. *Frambæsial*.—Yaws may cause an inflammatory condition of the rectum and anus, which clears up after intravenous injections of arsenic (N.A.B.).

When local measures fail, severe and long-continued proctitis with ulceration or stenosis may call for colostomy.

Rectal Stricture.—Five varieties may be recognized:

1. *Congenital*.—Situated at the junction of rectum and anal canal, and due to persistence of the remains of the membrane separating proctodæum from the post-allantoic gut.

2. *Spasmodic*.—Results from submucous fibrosis with contraction of the external sphincter muscle, in association with anal fissure. It is probably due to a low-grade and long-continued infection which has gained admission through the tear.

3. *Post-operative*.—Usually in the anal canal following operations for piles; it is felt as a fibrous ring, sometimes with considerable underlying induration.

4. *Simple or Inflammatory*.—May follow any variety of proctitis; particularly gonococcal, and is linear, annular or tubular according as the rectal wall is involved in whole or part of its circumference, over a limited or wide area. The situation of the stricture varies, but it is usually accessible to the examining finger. The mucosa and submucosa are often soft and œdematous, forming polypoid masses; hæmorrhoids may coexist. Diffuse infiltration of the muscle coat is a feature of one form, which may follow syphilitic or tuberculous proctitis.

5. *Malignant*.—Often annular. This will be dealt with later.

The presence of a rectal stricture is usually indicated by obstructive symptoms, superadded to those of the pre-existing disease. Increasing difficulty in passing a motion, abdominal discomfort and colicky pain, may in time be followed by intestinal obstruction. On examination the rectum is often ballooned below a high stricture and the finger palpates a solid block of fibrous tissue unlike that found in any other rectal lesion.

Treatment.—(1) Dilatation, which must be repeated at regular intervals over a long period, may need a preliminary linear division of the sphincter (internal proctotomy). It is applicable to both congenital and post-operative strictures in the anal canal and to some in the lower end of the rectum. (2) External proctotomy, in which the posterior rectal wall is completely divided in the middle line from above the stricture to the anal margin, is of value in the presence of extensive ulceration and suppuration; free drainage is ensured and obstruction averted, the incontinence which follows being as a rule only temporary. (3) Excision of the stricture may be practicable in a few congenital cases, but usually aggravates the state of affairs in inflammatory stenosis, owing to the increased fibrosis which ensues. (4) Colostomy is the wisest course in all cases complicated by perirectal suppuration and fistulæ.

Perirectal and Perianal Infection.—The lower rectum and anal canal are more prone to infection than any other part of the intestinal tract, with the possible exception of the appendix. The two main factors contributing to this are the anatomical configuration of the lumen, *i.e.* anal sinuses and valves, columns of Morgagni, etc., and the liability to trauma from scybalous masses and small sharp foreign bodies in the stools. The great prevalence of constipation and hæmorrhoids among the populace can justly be held responsible. The organisms usually found are *Bact. coli*, staphylococci and streptococci, *B. proteus* and *B. tuberculosis* (15 per cent.). The

perirectal cellular tissue planes and intervening fatty tissue afford a favourable nidus for infection which, guided by the dense aponeurotic attachments of the various muscles, tends to track in many directions until a free surface is reached. The evacuatory movements to which the bowel is constantly being subjected contribute to this spread and delay the healing process.

Varieties.—An abscess may be of one or other of the following types:

1. *Perianal.*—A small subcutaneous collection of pus at the side of the anal verge, usually resulting from infection of a sebaceous or hair follicle (follicular abscess), an anal fissure or thrombosed external pile.

2. *Ischio-rectal.*—In this, the most common type, the source of infection is often hard to find. It must be assumed, therefore, that some minute abrasion of the bowel from inspissated fæces is responsible, or that the infection is blood-borne. More obvious causes are inflamed or sloughing piles, anal fissure, proctitis, and maladministered injections for hæmorrhoids; a tuberculous origin, usually secondary to pulmonary disease, is not infrequent. Pus may track towards (a) the overlying skin; (b) the bowel superficial to, through the substance of, or deep to the external sphincter; (c) the opposite ischio-rectal fossa via the ano-coccygeal route; and (d) the pelvi-rectal space by penetrating the levator ani.

3. *Submucous.*—Commencing in the lower rectum beneath the mucous membrane, the abscess tracks both laterally and downwards to the anal margin, leaving a submucous fistula after rupture.

4. *Pelvi-rectal.*—A rare type usually due to pelvic cellulitis in the female, to prostatic and vesical disease in the male, but sometimes caused by rectal ulceration, trauma or neoplasms.

Signs and Symptoms.—Throbbing pain, which may be intense and aggravated by sitting, walking or defæcation, pyrexia with associated toxæmia, and constipation are usual. Tenderness is often extreme and in marked contrast to the insignificance of the swelling; brawny induration, deep-seated fluctuation,

and œdema may coexist. When of tuberculous origin, discomfort may be slight until the abscess is on the point of bursting, which latter event may have occurred before advice is sought.

Treatment.—Free and early incision is of paramount importance, if intractable and complicated fistulæ are to be avoided. In perianal and ischio-rectal types the incision should be so planned that the edges retract widely, free drainage being thus ensured without the use of drainage tubes. Sub-mucous abscess needs opening at its lowest point in the rectal wall, while in the pelvi-rectal variety incisions may be called for in the iliac fossa, lumbar region or buttock, in addition to those in the ischio-rectal fossa.

Once these abscesses have been freely opened, frequent hot sitz-baths assist in the healing process and are soothing to the patient.

Ano-Rectal Fistulæ.—The term 'fistula in ano' is often employed to embrace the variety of tracks which may follow perianal and perirectal suppuration; the fistula is said to be *complete* when opening both on the skin and the mucous surface of the bowel, *incomplete* when on one surface only, *blind external* on the skin, *blind internal* into the bowel.

General Features.—(1) *External opening* may be small and single or large and multiple; the exact relationship to the anal orifice may be of diagnostic importance. (2) *Internal opening* may be small and circular or large and irregular, and at any point from the anal margin to several inches up the rectum. (3) *Main track* may be straight, curved or tortuous, varying in its relation to the muscles controlling the anus. (4) *Offshoots* or extensions of the main track may involve the same or contralateral aspect of the bowel.

• Spontaneous cure is very rare, and healing seldom follows palliative treatment—*e.g.*, hot applications, ionization of the track, measures to improve the general health. The reasons for this are: (a) constant reinfection from the bowel, (b) rigidity of the walls of the track, (c) lack of rest to the inflamed area, and

(d) incomplete drainage. In a limited number of cases complete excision of the track with primary suture is feasible. As a rule operation is restricted to free opening of the track from end to end, excision of as much of the indurated walls as possible, allowing the cavity to heal by granulation from the bottom. There still remains a small group in which the track cannot be opened from end to end without division of both external and internal sphincters, and of the insertion of levator ani into the rectal wall;

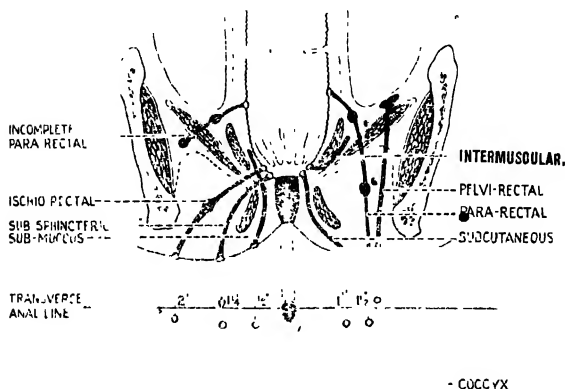


FIG. 51.—ILLUSTRATING ANO-RECTAL FISTULÆ.

the retraction of these muscles would result in permanent incontinence of feces. For this reason the exact relationship of a fistula to the muscles is of fundamental importance, and the following varieties may be recognized (see Fig. 51):

1. **Subcutaneous.**—The fistula lies in the subcutaneous tissue superficial to the external sphincter, the external orifice is small and within an inch of the anal margin, the internal opening is at the lower edge of an anal fissure and the track palpable as a superficial indurated cord. Complete excision of the tissues

superficial to the fistula presents no difficulties, and cure follows.

2. *Submucous*.—The track extends in the submucous coat from the lower rectum obliquely downwards towards the anal margin, and is usually unilateral; there may be but one opening, situated on the skin within $\frac{1}{2}$ inch of the anal margin, in either right or left posterior quadrant (blind external) or in the anal canal near an anal valve (blind internal); occasionally both openings are present (complete submucous fistula). Bilateral submucous fistula is the result of an abscess in the posterior wall of the rectum, which tracks towards both sides and opens in the middle line posteriorly at the level of Hilton's line.

Submucous fistulæ must be distinguished from para-rectal, and for this purpose a probe-pointed director should be passed along the track until the end projects through the internal opening or is arrested; in submucous fistula the edges of the groove in the director can be felt by a finger in the rectum, whereas in the pararectal type this is not possible.

Treatment.—The fistula should be laid open into the bowel. This may entail cutting across large hæmorrhoidal vessels, which are difficult to control when the tissues are simply incised. An alternative method is to pass two lengths of silk through the track, tying them so as to include between them the submucous and mucous coats covering the fistula; when sloughing occurs, the track is then widely exposed.

3. *Intermuscular*.—The rarest type, in which the track lies between the internal sphincter and the longitudinal muscle of the rectum. It seldom exceeds an inch in length, is always straight, with a single opening lying at the entrance to a sinus of Morgagni just above Hilton's line.

Treatment.—The track should be opened from end to end into the lumen of the bowel; this entails division of the internal sphincter, but no harm results.

4. *Pararectal*.—Results from an abscess in the space between the rectal wall and the fascia propria, above the level of levator ani. The internal opening is situated high up in the rectum, the track passing

outwards and downwards through levator ani into the ischio-rectal fossa; when of the complete variety, the external opening is on the skin more than $1\frac{1}{2}$ inches from the anal verge, slightly posterior to the transverse anal line. Bilateral pararectal fistula results from spread to both ischio-rectal fossæ; submucous extensions and lateral offshoots from the main track are common, and there may be multiple external and internal openings.

These fistulæ must be distinguished from pelvi-rectal and retro-rectal types, neither of which has an internal opening into the rectum; pelvi-rectal opens anterior to the transverse anal line at least $1\frac{1}{2}$ inches from the anus, retro-rectal at the level of the tip of the coccyx and about an inch distant from it.

Treatment.—*The track must never be opened completely into the bowel*, as permanent incontinence is bound to result from division and retraction of both the sphincter muscles at the line of fusion of the levator ani with the wall of the rectum. The fistula should be freely exposed by a T-shaped incision in the ischio-rectal fossa, and the tissues on the outer side of the main track divided as far as the point where it passes through the rectal wall, care being taken to incise levator ani in the direction of its fibres. Any foreign body should be removed, lateral extensions of the main track freely opened, but the internal opening not interfered with; the latter will close as the main track becomes obliterated.

5. *Subsphincteric.*—The track lies deep to the external sphincter, the external opening being situated about $1\frac{1}{4}$ inches from the anal margin in variable relation to the transverse anal line. When the opening is anterior to or on this line, the main track is straight and the internal opening is between the sphincters in the same radial line; when the external opening lies posterior to the transverse anal line, the internal is in the middle line posteriorly between the sphincters, the track curving backwards between the two openings. Bilateral subsphincteric fistula has a straight main track at or near the middle line anteriorly, with lateral extensions (anterior horseshoe fistula).

Subsphincteric fistula must be distinguished from the subcutaneous variety and from urethral fistulæ; the induration is more deeply situated than in subcutaneous fistula, while the urethral type is associated with a stricture of the urethra, does not communicate with the rectum, and has a track running forwards towards the scrotum.

Treatment.—The track should be laid freely open and careful search made for any associated sub-mucous or intermuscular extension, which must be opened up if found.

6. *Ischio-rectal.*—The external opening is usually about 2 inches from the anal margin and slightly behind the transverse anal line. The main track always curves backwards towards the internal opening, which is invariably in the middle line posteriorly between the sphincters. Bilateral ischio-rectal fistula (posterior horseshoe) results from symmetrical infection of the ischio-rectal fossæ.

Treatment.—The main curved track should be opened in stages from end to end, with lateral relieving cuts to prevent premature union of the skin edges before granulations have filled the deeper parts. Any offshoots or extensions should be similarly dealt with.

It must be borne in mind that more than one type of fistula may co-exist in the same patient.

Fifteen per cent. of ano-rectal fistulæ are of tuberculous origin; when superficial to the sphincters cure usually results from free exposure of the track in combination with surgical diathermy, but operation is contra-indicated in the deeper varieties.

An opening likely to be mistaken for that of an ano-rectal fistula may be found in or near the mid-line posterior to the anus. It is the result of suppuration in a post-anal dermoid or sacro-coccygeal teratoma (see p. 260). In some cases hair may be noticed on careful examination. A probe introduced into the sinus passes backwards towards the sacrum, often for a considerable distance, while induration is absent anteriorly. The entire track should be excised, otherwise recurrence is inevitable.

Hæmorrhoids or Piles.—Under this heading is included a number of lesions of the lower rectum and anal region, due in most cases to varicosity of the submucous and subcutaneous veins. The term *internal pile* is used for those covered by rectal mucous membrane, *external* for piles covered by squamous epithelium, *intero-external* partaking of the characters of both types.

Pathology.—As in cases of varix elsewhere, a strong hereditary influence must be assumed. Congestion of the rectal veins is a normal incident during the act of defæcation, as is eversion of the anal margin during the passage of the stool. On completion of the act the rectum should be empty, the muscular coats relaxed and the circulation through them unimpeded, aided by the normal elasticity of the subcutaneous and submucous cellular tissue. Prolonged congestion may be brought about by (1) chronic constipation, with pressure of the retained stool on the rectal wall; (2) the habit of straining at stool, apart from constipation; (3) frequent use of saline purges; (4) occupations involving heavy manual labour, with a thirst which is quenched by large amounts of beer; (5) prolonged standing; (6) habitual gorging or over-consumption of alcohol; (7) portal congestion from obesity; (8) repeated pregnancies causing increased laxity of the lower rectum and anal region; (9) repeated straining from urethral stricture, chronic bronchitis, etc.; (10) local causes—*e.g.*, enlarged prostate, proctitis, colitis, carcinoma of rectum; (11) abdominal tumours, cirrhosis of liver, hyperpiesis; (12) myocarditis.

The passive congestion so induced may lead to varicosity of the anal and rectal veins, but apart from this the normal subcutaneous and submucous elastic tissue becomes replaced by inelastic white fibrous tissue (replacement fibrosis). The latter in turn interferes with the circulation, the nutrition of the skin and mucous membrane is impaired and infection with low-grade organisms favoured.

The longitudinal mucosal folds of the lower rectum (columns of Morgagni), containing the terminal

branches of the superior hæmorrhoidal artery surrounded by a plexus of thin-walled valveless veins, give rise by their enlargement to *primary* piles; this artery usually divides into right and left branches, the former subdividing into anterior and posterior divisions. This accounts for the frequent distribution of primary piles into three main masses situated respectively in the right anterior, right posterior and left posterior quadrants. In most advanced cases the areas between these columns are also affected, producing *secondary* piles.

The lost elasticity and increased laxity of the submucous and subcutaneous tissues, to which may be added spasm of the anal musculature when cracks, fissures or ulcers coexist, prevent the normal recoil of the parts at the end of defæcation. Prolapse of an internal pile may thus occur; it may be followed by spontaneous reduction (second-degree pile) or need digital replacement. At a later stage the stretched anal orifice may permit of prolapse after standing or exercise which calls for manual reposition (third-degree pile).

Complications are thrombosis and strangulation, which may be followed by sloughing, ulceration and infection, leading to perirectal suppuration. Fibrosis often results from thrombosis or strangulation.

Signs and Symptoms—1. *External Piles*.—Under this term three conditions are included: (a) Circumscribed blood extravasation at the anal margin; (b) redundant folds of perianal skin; (c) dilated perianal veins. In (a) there is a sudden onset of pain in the anal region and defæcation is checked by spasm of the sphincter. The swelling is at first tense and bluish, but later becomes unyielding. Usually there is spontaneous resolution. In (b) there is a tendency to pruritus unless great care is exercised with anal hygiene. In (c) there is a sense of fulness and swelling at the anus.

2. *Internal Piles*.—Here the first symptom may be the loss of a few drops of blood on defæcation or mere sense of fulness or local irritation. Prolapse, rectal discomfort with a feeling of incomplete evacuation, mucoid discharge and pruritus ani

appear later. Actual pain, usually of a throbbing nature, indicates thrombosis near the anal outlet, strangulation, or the onset of suppuration. Inspection of the anal region may disclose (a) soft redundant folds of skin radiating from the orifice (intero-external piles); (b) small skin tags closely adherent at their bases to the atrophied subcutaneous tissue; (c) dilated bluish, thin-walled veins; (d) a localized oval or elongated bluish-black swelling, tense and tender to the touch (anal hæmatoma or thrombosed external pile); (e) a hard, mobile, fibrous, subcutaneous nodule resulting from organization of a thrombosed pile; (f) one or more soft, dark red swellings prolapsing through the anus (internal piles); (g) large œdematous, black, ulcerated and sloughing masses with an offensive odour (strangulated piles); or (h) a pedunculated, pale, smooth polypoid swelling (fibrous pile).

When the patient is asked to strain, underlying varicose veins may be seen through the skin, internal piles may prolapse, and laxity or hypertrophy of the anal musculature be noted. Digital examination of the rectum and anal canal discloses internal piles only in the later stages, when submucous fibrosis is present. Proctoscopy allows a clear view of the number, position, size and degree of the piles.

Diagnosis.—Care must be taken to exclude other lesions—*e.g.*, anal fissure with a sentinel tag, fistula, proctitis or carcinoma of the rectum—before a diagnosis of simple hæmorrhoids is arrived at. Many lives have been sacrificed by the institution of palliative measures for hæmorrhoids, the co-existence of carcinoma of the rectum having been overlooked.

Treatment.—I. *Palliative.*—Of value for (a) early cases, (b) those associated with pregnancy, and (c) strangulated and infected piles. In the former, saline purges should be avoided, a light diet with ample fluids and fruit enjoined, and the bowels regulated with liquid paraffin (plain or in emulsion with agar-agar, milk of magnesia and phenolphthalein). Senna in the form of confection or infusion (senna tea) may also be useful. Creams containing adrenalin, hamamelis and olive oil are of value, and may be inserted into

the rectum by the finger or a vulcanite introducer, both at night and before defæcation. Strangulated prolapsed piles must be reduced as soon as possible, either by gentle pressure alone or after stretching the anal sphincters under anæsthesia. The patient should be confined to bed; and heat applied by sitz-baths or hot fomentations until all œdema has subsided.

2. *Injection Treatment.*—This is indicated for uncomplicated internal piles of the first and second degrees only. The best results are obtained when bleeding is a prominent symptom, whereas when prolapse is marked and the piles partake of the characters of the intero-external type, the relief is usually temporary and incomplete. The object of the treatment is to produce submucous fibrosis with obliteration of the vascular plexuses; this is achieved by injection of 5 per cent. phenol in almond oil or 20 per cent. phenol in glycerine and water.

Technique.—A rectal speculum is introduced for its full length, the obturator removed and the wall of the bowel inspected; as the instrument is slowly withdrawn the upper ends of the piles come into view. A special guarded needle attached by a bayonet joint to a glass-barrelled syringe of 1 to 5 c.c. capacity is employed, the point being inserted obliquely through the mucosa at the base of a pile. Care must be taken, by movement of the needle from side to side, to ensure that the point lies in the submucosa before injection is commenced; 3 to 5 c.c. of the 5 per cent. solution or 3 to 5 minims of the 20 per cent. phenol are then injected. As a rule two or three piles may be treated at one sitting, to be repeated at intervals of two to three weeks. There may be a feeling of distension as the fluid runs in, but actual pain indicates an error in technique—*e.g.*, injection too low in the anal canal or into tissue sclerosed from a previous injection.

3. *Operation.*—With the exception of those outlined above, all cases of internal, intero-external, or external piles are best treated by operation; in actual practice this applies to 50 per cent. of the total.

The most satisfactory method for internal and intero-external piles is some form of ligature operation, with or without transfixion. External skin tags should be excised, leaving the wounds to heal by granulation. Thrombosed external piles sometimes call for incision and evacuation of the clot when pain is severe.

Anal Fissure.—A term usually applied to a single tear in the anal mucosa, the common cause being passage of a constipated stool; it may also be due to excessive straining, sometimes in association with diarrhoea, laceration by a foreign body, or tearing down of an anal valve or hypertrophied anal papilla. The usual site is in or close to the mid-line posteriorly, possibly from weakness of the external sphincter at this site; anterior fissure is rare in men (1 per cent.), less so in women (8 per cent.). Multiple superficial fissures are found in association with atrophy of the anal skin and mucosa, with underlying fibrosis and a contracted outlet.

The exposure of sensitive nerve endings in the base of the tear produces a reflex spasm of the sphincters which, in conjunction with infection and lack of rest, conduces to chronicity. Fibrosis of the base and margins of the fissure, with œdema of the skin at the lower end, results in the formation of a 'sentinel tag.' Such a fissure is a fruitful source of fistulæ.

Signs and Symptoms.—Sharp, stabbing pain in the anal region during and after defæcation is almost diagnostic; it is often so acute that the act is deliberately postponed, with resulting constipation. Slight bleeding is usual; discharge, pruritus and reflex urinary symptoms may be complained of. Inspection of the anus reveals the sentinel tag, while gentle retraction of the anal margins exposes the lower end of the fissure; a small fistulous opening may also be seen. Spasm or hypertrophy of the sphincters and induration of the base of the fissure may be detected on palpation.

Treatment.—1. For fissures of recent origin, when sphincteric spasm alone is present, injection of novocaine followed by proctocaine or other oil-soluble

anæsthetic solutions over a fan-shaped area is indicated. The injection is made through a wide-bore needle into the base and margins of the fissure, starting 1 inch behind its posterior margin, and produces immediate anæsthesia with relaxation of the sphincters. If required, it may be followed by excision of the indurated margins and base of the fissure, together with the sentinel tag. The raw surface left may be dressed with a cream containing tinct. benzoin co. and olive oil, inserted into the rectum night and morning. The bowels should be regulated by liquid paraffin, supplemented by confection of senna, ample fluid and fruit.

2. When the sphincters are hypertrophied and submucous fibrosis is marked, operation is indicated. Excision of indurated fibrous tissue around the fissure should be combined with free division of the transverse constricting band of submucous fibrous tissue in the anal canal (pecten band). Daily dilatation of the anus with a gum-elastic bougie should be continued until healing is complete.

3. All cases complicated by fistula, hæmorrhoids, etc., need operation.

Rectal Prolapse.—When mucous membrane only projects, it is termed *partial*; if the whole thickness of the rectal wall is affected, *complete* prolapse is the result.

Etiology.—In children the main factor is prolonged straining at stool, sometimes augmented by wasting or debility, and the prolapse is usually partial. In adults partial prolapse may result from hæmorrhoids, loss of sphincteric tone in old age, tabes dorsalis, enlarged prostate, urethral stricture, or follow operations for piles or fistulæ in the debilitated; the prolapse often involves one portion only of the anal circumference. Complete prolapse is more common in elderly women, but not necessarily those who have borne children.

Signs and Symptoms.—Blood-stained discharge and local discomfort result. A partial prolapse is usually $\frac{1}{2}$ to 1 inch in length, the mucosa oedematous and smooth; a complete one is several inches long,

the mucosa raised into circular folds, and the prolapse forms a much bulkier projection. The anal orifice and sphincters are dilated and patulous.

Treatment.—1. *In Children.*—The bowels should be controlled by liquid paraffin, ample fluids and suitable diet. After a few daily enemata, the child should be taught to defæcate without prolonging the act. An alum douche after each motion may be helpful. Linear cauterization of the mucosa may be needed for more advanced cases, or the injection method described below, applied in a modified form.

2. *In Adults.*—(a) Partial prolapse: Excision of the prolapsed portion is usually best, using a modification of the ligature operation as for internal piles, combined with galvanism to the sphincter, aided by voluntary daily contraction of the anal orifice. (b) Complete prolapse: Submucous injection of 1:2,000 HCl should be combined with pararectal infiltration at each of three sites, lateral and posterior. Sphincteric exercises should be practised daily, the bowels being kept confined for a week and then opened by enemata. Plastic operations on the perineum and external sphincter are sometimes advised. Amputation of the prolapsed rectum, sigmoidopexy and rectopexy have their advocates.

Pruritus Ani.—The anal region is peculiarly susceptible to irritation, which may become distressing and intractable for the following reasons: (1) The rich supply of sensitive nerve endings; (2) the frequency of lesions associated with excessive moisture or discharge; (3) the difficulty of carrying out perfect cleansing after defæcation, especially with modern toilet paper. The repeated scratching to which the skin is subjected, often when the patient is half asleep, results in excoriations, through which infection of the skin and subcutaneous tissue takes place. This is followed by fibrosis and thickening of the skin, which becomes ridged; interference with the blood supply and loss of elasticity of the skin predispose to multiple cracks and fissures. Toilet becomes increasingly difficult and a vicious circle results. The nervous system of the patient suffers

as a consequence of loss of sleep, and a marked anxiety-state tends to aggravate the pruritus.

Causes.—(1) Imperfect toilet after defæcation. (2) Excessive sweating and friction of rough underclothes. (3) Local lesions of the anal region associated with discharge or excessive moisture—*e.g.*, anal fissure or ulcer, warts, condylomata, perianal abscesses and fistulæ, skin tags, etc. (4) Rectal lesions associated with discharge—*e.g.*, prolapsed piles, prolapse of the rectum, proctitis and carcinoma. (5) Threadworms. The adult female *Enterobius vermicularis*, containing numerous ova, causes pruritus by its wriggling movements in the anal region. Retraction of the anal margins, when irritation is active, sometimes discloses the white, threadlike worms; the inspection should be carried out in a warm atmosphere, otherwise the parasites may retreat into the rectum. In doubtful cases proctoscopy, or examination against a black background of the fluid returned following a salt enema, may be of value. An important point in treatment is the avoidance of reinfection from ova deposited on the skin and underclothes; the patient's hands must always be washed after touching any part of the body surface or the lingerie, and the anal region should be anointed night and morning with ung. hydrarg. ammon. (6) Spread from vulval pruritus, due to a variety of gynæcological causes. (7) Diabetes mellitus.

Treatment.—1. Attention to the general health, combined with suitable diet, nerve sedatives and removal of the local cause, cures a large number of early cases. Local applications of a cream containing zinc ointment, Friar's balsam and olive oil are useful, when excoriations or fissures are present. The anal region should be cleansed with cotton-wool after defæcation and a reliable dusting powder applied (Fuller's earth); the underclothes should be soft and laundered without the use of soda.

2. **Injection Treatment.**—The object of this is to produce anæsthesia or hypoæsthesia for a sufficient length of time to allow the patient's nervous system to return to normal, for local excoriations and infec-

tion to subside, and to permit of the application of such remedies as silver nitrate during the anæsthetic phase. Various strengths of alcohol, quinine-urea $\frac{1}{2}$ per cent. with novocaine $1\frac{1}{2}$ per cent., hydrochloric acid (1 : 2,000), proctocaine or percaine in oil all have their advocates; they are injected subcutaneously.

3. *Operations*.—Various operations have been devised with the object of undercutting the perianal skin, to bring about anæsthesia; they are liable to fail in their purpose, producing a patchy anæsthesia of temporary duration, and in some cases induce trophic changes in the skin. An alternative method is to excise the main sensory nerves to the anal and perianal region, an operation complicated by the fact that sensory fibres are intermingled with motor fibres to the external sphincter; faradic stimulation of the main branches will facilitate section of the correct portions of the nerves.

4. *Irradiation*, by X-rays or teletherapy, has been applied with success in some cases of pruritus which have failed to respond to other measures.

Neoplasms.—1. **Adenoma**, a common tumour of the rectum, is liable to undergo malignant changes. Commencing as a small, soft, lobulated, sessile swelling, it becomes pedunculated, frequently reaching and sometimes exceeding the size of a cherry. Ulceration of the surface or induration of any part of the polypus must be regarded as a probable indication of malignant transformation. In children, adenoma may cause rectal hæmorrhage or prolapse on defæcation; in adults, bleeding, discharge, tenesmus and pruritus are common symptoms.

Treatment.—(1) Local excision by ligation of the pedicle may be employed for a polypus in the lower half of the rectum. (2) Diathermy may be applied to the surface of a sessile adenoma, and in the form of a snare is also of value for removing pedunculated growths high up in the rectum.

2. **Multiple Adenomata** form an important group of cases, some of which display a marked familial or hereditary tendency (polyposis intestini), while others are acquired (multiple adenomatosis). Bilharzial in-

fection must always be borne in mind, especially in those who have resided in the East.

Treatment.—The pronounced tendency of these tumours to undergo malignant changes would appear to be a strong argument in favour of excising the whole area in which they are liable to occur, but as this would involve complete colectomy and excision of the rectum, leaving the patient with ileostomy, it is not often justified. An alternative course consists in treating polypoid masses in the rectum by diathermy, occasional colonic lavage, and regulation of the diet. Should carcinoma supervene, radical extirpation of the affected portion of the bowel is called for.

3. **Papilloma.**—A villous tumour which is usually soft and sessile, and may cover large areas of the rectum; it sometimes forms a localized mass projecting into the fecal lumen. Malignant changes appear to supervene in nearly 50 per cent. of cases. Profuse discharge of mucus and diarrhoea are usual, bleeding being more pronounced when the growth arises in the lower rectum, when it is liable to prolapse.

Treatment.—(1) Local excision is only practicable for a small growth low down in the rectum. (2) Radical excision of the rectum is the operation of choice for all other cases; colostomy followed by perineal excision of the rectum may be advisable in debilitated subjects. Conservative excision with preservation of the sphincters is not to be recommended.

4. **Carcinoma.**—The rectum is one of the commonest sites of cancer, the maximum incidence lying between fifty and sixty years and males preponderating slightly.

Pathology.—The growth is usually a columnar-celled adeno-carcinoma derived from the cylindrical cells of Lieberkühn's follicles, the common sites of origin being (a) recto-sigmoidal junction; (b) middle of the ampulla, commencing on the posterior wall; and (c) anal canal, nearly always in the middle line anteriorly. Four clinical types may be recognized: (1) Annular: Occurs at the recto-sigmoidal junction, giving rise to a circular ring stricture with excessive fibrosis and little tendency to metastasize. (2) Papil-

liferous: Projects into the lumen of the bowel, is of low malignancy, and may become ulcerated. (3) Ulcerative: Forms a flattened nodular sessile growth which becomes crateriform with everted and indurated edges; the rectal wall may be penetrated and lymphatic extension is often an early feature. (4) Colloid or mucoid: The result of mucinoid degeneration in both epithelium and connective tissue; the tendency here is to rapid growth and high malignancy.

The disease spreads slowly by direct extension, both through the wall of the rectum and around the transverse axis of the bowel; in an average case six months elapse before the growth has embraced a quarter of the circumference of the ampulla, the fascia propria not being invaded until eighteen months have passed and three-quarters of the circumference of the bowel is involved.

Lymphatic Spread.—(1) Intramural: The submucous lymph vessels do not form a continuous plexus, but arboresce in such a way that small circumscribed areas of the bowel drain separately into vessels which pass through the circular muscle coat to join the intermuscular network. (2) Intermediary: Vessels from the intermuscular plexus pierce the external muscle coat and drain into a subserous plexus where the rectum is covered by peritoneum, beyond this into a lymph sinus between the bowel wall and perirectal fat. (3) Extramural: Scattered over the surface of the rectum, among the branches of the superior hæmorrhoidal vessels, are the ano-rectal glands and an extensive plexus of lymph vessels. Efferents pass from these in three directions: (a) Downwards through the fatty tissue of the ischio-rectal fossa into Alcock's canal, emptying into the internal iliac glands; on the way there is free communication with the perianal lymph vessels. (b) Laterally to a plexus between levator ani and the pelvic fascia, thence to the obturator and eventually to the internal and external iliac glands. (c) Upwards in company with the superior hæmorrhoidal veins into the lowest mesocolic (retrorectal) glands, from there to the glands at the bifurcation of the left common iliac

artery, and ultimately to the aortic glands. This group of vessels communicates freely with those from the paracolic glands situated along the mesocolic border of the pelvic and descending colon.

Signs and Symptoms.—In the first few months the condition is often latent, but the onset of constipation, which tends to be persistent, is sometimes a characteristic feature. In the succeeding stage the symptoms vary with the position of the growth:

1. *Recto-sigmoidal Region.*—Papilliferous growths

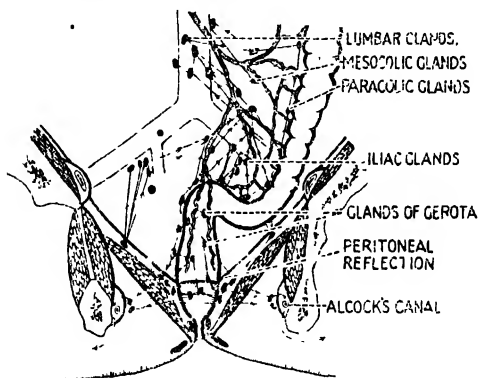


FIG. 52.—TO ILLUSTRATE LYMPHATIC DRAINAGE OF RECTUM AND SIGMOID COLON.

give rise to excessive mucous secretion and diarrhœa, the stools being frequently tinged with blood; the diarrhœa may come on after meals or the ingestion of warm fluids. Annular and ulcerative growths are usually first indicated by intestinal obstruction—*i.e.*, abdominal distension, visible peristalsis and colicky pain.

2. *Anal Canal.*—Considerable discomfort is an early feature. The rectum feels as if evacuation is incomplete, while pain may be so acute as to suggest an anal fissure, and bleeding is an early sign.

3. *Ampulla.*—In the pre-ulcerative stage, symp-

toms are usually slight; constipation, a sensation of fulness and incomplete evacuation may be noticed, while later there may be looseness and frequency of the motions. When ulceration occurs the rectum becomes irritable, frequent small stools containing excess of mucus tinged with blood are passed, and tenesmus is present. Pain of an aching character is usually slight until the wall of the bowel has been penetrated and suppuration is added; it then becomes constant and throbbing. In the later stages offensive rectal discharge, irregular pyrexia, emaciation and anæmia, attacks of obstruction alternating with spurious diarrhœa, and severe hæmorrhages may all be seen. Extensive perirectal suppuration with fistulæ, invasion of the sacral plexus, bladder, prostate and vagina cause distressing symptoms, which are eventually relieved when ascites, jaundice, and œdema of the lower limbs end in death.

Diagnosis.—It may be taken as a sound working rule that, in all adults developing constipation or rectal symptoms, the presence of cancer must be excluded before any treatment is instituted for other rectal lesions. Digital examination, proctoscopy, sigmoidoscopy, and skiagraphy after a barium enema may all be needed before a tumour of the rectum is discovered. The well-marked tendency of many innocent rectal neoplasms in adults to undergo malignant transformation has already been alluded to; therefore any ulceration, induration or infiltration of the base of these tumours calls for a biopsy before local treatment is undertaken. Adenomyoma arising from misplaced endometrial cells may infiltrate the recto-vaginal septum and rectal wall; in this also biopsy will establish the diagnosis.

Treatment.—1. Radical extirpation of the rectum offers the main hope of cure. Any operation designed for this purpose must be based on a study of the methods of spread of the disease; it should include removal of as much as possible of the tissues through which spread is liable to occur. To meet these requirements and to decide the feasibility of radical excision of the growth, it is essential to explore the

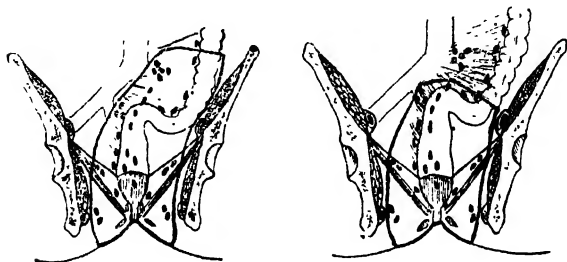
peritoneal cavity by the abdominal route. The abdomino-perineal method of Miles fulfils these desiderata, and enables complete excision of the pelvic mesocolon, mesorectum, pelvic cellular tissue and most of the pelvic peritoneum, with the contained lymphatics, to be performed under direct vision.* The operation is a severe one and must be expected to carry with it a mortality of 20 per cent.; for a successful issue it demands judicious selection of cases and careful pre- and post-operative treatment. An alternative method of radical excision is the perineo-abdominal operation, carried out in two stages. In the first stage the abdomen is opened, operability assessed, and a left iliac colostomy performed. Two or three weeks later the rectum is freed from below and resection completed from above, including the original colostomy, which is replaced by a terminal one. It has been advocated to carry out this operation in one stage, but the advantages claimed do not outweigh the manifest objection that it prolongs unduly what is always a serious procedure. Recently simultaneous abdominal and perineal procedures by two surgeons co-operating have been claimed to reduce the operative mortality.

2. Perineal excision of the rectum, performed two to three weeks after laparotomy and the establishment of a left iliac colostomy, is of necessity a more restricted operation, which can hardly be termed radical in its relation to the upper field of lymphatic spread. Nevertheless it is of definite value for debilitated and elderly subjects, as also for certain growths in the anal canal. The operative mortality is about 10 per cent.

3. Abdominal excision is of use for a limited number of cases involving the recto-sigmoidal region, in which, on general grounds, more radical resection is contra-indicated. In rare cases an axial anastomosis *in situ* may prove feasible, but more often Hartmann's method is chosen—*i.e.*, the lower end of the rectum is closed after extirpation of the neoplasm, and permanent colostomy established.

4. *Irradiation*.—Radium has been employed inter-

stitially in the form of needles or seeds, inserted by the abdominal route, through the perineum or via the lumen of the bowel, and radium applicators as well as telerradium (for anal neoplasms) may prove helpful. Considerable palliation may result, but in



1.

Abdomino-perineal excision:
Mortality, 20 per cent.; five-
year survival rate, 60 per cent.

2.

Perineal excision: Mor-
tality, 10 per cent.;
five-year survival rate,
40 per cent.

FIG. 53.—SCOPE OF OPERATION IN (1) ABDOMINO-PERINEAL, (2) PERINEAL EXCISION.

some cases the treatment is followed by a distressingly painful period.

5. *Colostomy* is indicated when excision is out of the question, particularly when obstructive symptoms or excessive discharge and pain are prominent features.

CHAPTER XLI

AFFECTIONS OF THE KIDNEYS, URETERS AND SUPRARENALS

A SUSPICION of a surgical lesion of one or both kidneys involves the necessity to establish as far as possible the size, shape, position, and particularly the functional capacity of both organs.

Palpation will reveal gross enlargement, for the tumour can be grasped bimanually in the loin, while percussion reveals a band of resonance due to the colon crossing it anteriorly.

Skiagraphy will indicate the presence of calculi or calcareous tuberculous foci, as well as the outline of an enlarged, deformed or displaced kidney. The intravenous injection of a non-toxic substance such as 'uro-selectan B,' which is excreted in the urine and is opaque to X-rays, is invaluable. By this it is possible to detect the absence of a kidney or diminution in its functional capacity, the various degrees of hydronephrosis, such abnormalities as horseshoe or discoid kidneys, and distortion of portions of the renal shadow produced by renal or suprarenal tumours. It may help also to confirm the nature of any opacity lying in or near the urinary tract.

Cystoscopy permits, in addition to a detailed scrutiny of the prostate and bladder, the examination of the efflux of urine from the ureteric orifices; it is thus possible to compare roughly the functional activities of the two kidneys, as well as to detect blood or pus in the effluents. More precise information is provided by *chromocystoscopy*; 10 c.c. of a 0.2 per cent. solution of indigo-carmin is injected intravenously, and within seven minutes imparts a distinct blue colour to the urine issuing from each ureteric orifice. Delay in excretion is a rough guide to the degree of functional renal defect. Phenolsulphonephthalein is less convenient, as it necessitates accurate colorimetry, but properly fractionated it is superior in accuracy to the indigo-carmin test.

Chemical Analysis of the Blood and Urine.—It is to be assumed that the volume of urine passed in twenty-four hours has been estimated and that the usual chemical and microscopical tests have been applied. The effect of the ingestion of 15 grammes of urea in 100 c.c. water on the percentage of urea in the urine, taken subsequently at hourly intervals for three hours, is a most reliable test of renal function (urea concentration test). Usually in health the figure is above 2.5 per cent., but if over 2 per cent.

it is unlikely that the kidney is seriously damaged. If the diuresis following the tests is exceptionally high, this must be taken into consideration. It is

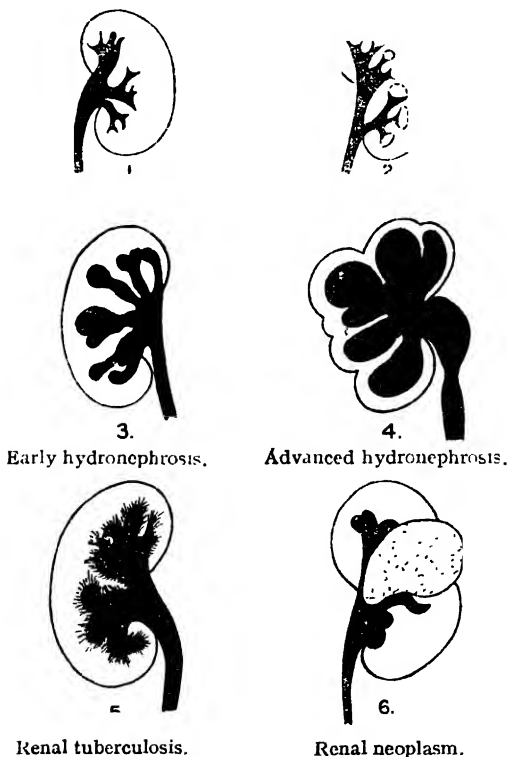


FIG. 54.—ILLUSTRATING PYELOGRAPHIC APPEARANCES

also essential at the same time to estimate the amount of urea in the blood. Normally 15 to 40 milligrammes occur in 100 c.c. blood, and any increase

of this figure above 45 is evidence of defective renal function; but the higher the blood urea figure, the more significant of renal insufficiency is a poor urea concentration. Van Slyke's urea clearance test is more reliable. The blood urea, the urea content of the urine, and the volume of urine excreted over a definite period are measured so that the output in c.c. per minute can be calculated. The clearance is calculated for each of two hours and the mean taken. Using Van Slyke's formula, 70 to 120 is regarded as the normal range, and figures under 70 indicate a degree of renal deficiency. Urinary infection lowers the clearance value. In prostatic cases figures above 60 are satisfactory. If comparison is to be made between the two kidneys, ureteric catheters are introduced into the renal pelvises, equal volumes of urine withdrawn from them at the end of the concentration test, and the urea in each specimen separately estimated.

Congenital Malformations and Displacements.—

1. Complete absence of one kidney is rare, advanced atrophy less so.

2. Horseshoe kidney or fusion of the lower poles across the spine is met with in about 0.1 per cent. of bodies. A more complete fusion to form a single discoid kidney is also met with. In both types there is a tendency to duplication of ureters, abnormality of blood supply, etc.

3. Lobulated kidney is common, but of little significance.

4. There are sometimes two or more ureters on each side, which may or may not reunite before emptying into the bladder. The renal pelvis is, in such cases, occasionally subdivided.

5. The renal artery is often abnormal. Most frequently there is an accessory artery running to the upper pole of the kidney, but if an aberrant artery supplies the lower pole, it is often associated with a tendency to hydronephrosis.

6. The kidney may be congenitally displaced so as to lie over the sacro-iliac joint or in the true pelvis.

7. Hydronephrosis, polycystic disease and, in very rare cases, renal sarcoma may be congenital.

Movable Kidney or Floating Kidney.—Normally the kidney has a certain mobility on respiration, and this mobility can vary widely in different individuals without any symptoms whatever. Three degrees are recognized, based on excretory pyelograms: (1) The pelvis rests opposite the third lumbar vertebra; (2) the pelvis rests opposite the fourth lumbar vertebra; and (3) the pelvis rests opposite or below the fifth lumbar vertebra.

The condition is nearly always part of a generalized visceroptosis, is ten times as common in women as in men, and at least ten times commoner in the right kidney. Many a neurasthenic woman with Glénard's disease would never have located her pains to a mobile kidney, had it not been for the injudicious statement of the medical adviser that her discomforts were 'due to a floating kidney.' The symptoms ascribed to movable kidney are aching pains in the loins, nausea, vomiting and constipation. Sharp attacks of pain in the right loin and groin (rarely on the left), with increase of size and tenderness in the kidney, sometimes with hæmaturia, together comprise what is termed a *Dietl's crisis*. This is ascribed to kinking of the ureter or to torsion of the vascular pedicle.

Treatment.—It is rarely advisable or justifiable to operate. The treatment should be that indicated for visceroptosis (see p. 461). Only when there is clear skiagraphic evidence of hydronephrosis, or definite indication of septic or other complications, should nephropexy be carried out. This complete fixation of a normally mobile organ often fails to give permanent relief, but unfortunately the neurasthenic patient invariably acclaims the operation as a success for a time, and nephropexy is still far too often performed.

Injuries of the Kidney are due to crushes, kicks, stabs or gunshot wounds. All degrees of damage may be met with. Bleeding may occur around the kidney, into the parenchyma, or within the pelvis, in

which case hæmaturia follows unless the ureter is torn across. The peritoneum may be ruptured with evidence of intra-abdominal hæmorrhage, or the whole kidney may be pulped or torn from its pedicle. If the rupture involves the pelvis or calyces urine will escape, and consequently infection of the extravasated blood is likely to follow, the organisms responsible being blood-borne. In rare cases the route is by direct spread from damaged bowel.

Symptoms.—These necessarily depend on the nature of the trauma and the extent of the damage. Slight and localized injuries may be detected only by a sharp attack of hæmaturia, which often clears up rapidly, but may recur. In most cases shock is severe and often complicated by symptoms due to the large amount of blood lost. Renal colic follows if clots pass down the ureter, and the presence of ureteric blood casts may be helpful in diagnosis. Swelling in the loin follows extensive perinephric hæmatoma, with or without the addition of extravasated urine. Signs of intraperitoneal hæmorrhage—*e.g.*, pain, distension, a rising pulse rate, thirst, restlessness and pallor—may be present.

Treatment.—Complete recumbency, ice-bags to the loins, and, if the diagnosis is quite clear, morphine or other sedatives. Severe persistent bleeding sufficient to threaten life demands blood transfusion, followed as a rule by nephrectomy. Few injuries requiring immediate operation lend themselves to conservative repair. Later the onset of perinephric urinary abscess may necessitate drainage, or in certain instances the development of hydro- or pyonephrosis will require nephrectomy. In all cases excretion urography is desirable before permitting patients to get up.

Hydronephrosis.—Intermittent or partial obstruction to the outflow of urine from the kidney eventually leads to distension of the pelvis, calyces and parenchyma. There are two main anatomical types: *renal*, when the dilatation affects chiefly the calyces and renal substance; *pelvic*, when there is gross distension of the pelvis, with at first little

abnormality of the renal tissues. If some urine escapes into the bladder, the term *open* hydronephrosis is used, otherwise it is called *closed*.

Causes.—These are very numerous, but it should be clearly understood that in an appreciable percentage of the cases no actual mechanical cause can be detected, and that, therefore, they may be due to disorders of innervation, comparable possibly with such diseases as achalasia of the cardia. Obstructive lesions in connexion with the urethra, prostate or bladder determine bilateral hydronephrosis, obstruction to the ureter, unilateral distension.

Congenital.—(1) Phimosis; (2) urethral or ureteral valves or stenosis; (3) aberrant renal artery (to lower pole).

Acquired.—Obstruction occurs (a) inside the lumen of the ureter—*e.g.*, stone; (b) in its wall—*e.g.*, inflammatory stricture; or (c) outside—*e.g.*, cicatrices after pelvic cellulitis. In addition, any form of kinking of the ureter, as in nephroptosis, or any obstruction in the bladder, prostate, or penis may induce hydronephrosis.

Symptoms.—Sometimes these are entirely absent even if the tumour be of great size. More often there is a dull ache in the loin, and occasionally attacks of severe renal colic, sometimes with hæmaturia, the pain radiating to the groin or testicle. If the lesion is bilateral, symptoms of chronic uræmia develop—*e.g.*, thirst, headaches, anæmia and the passage of pale urine of low specific gravity. In rare cases the condition is intermittent and the hydronephrotic cavity empties itself, with cessation of pain and the passage of a large amount of urine. Septic complications—*e.g.*, pyonephrosis—are always to be feared.

Diagnosis is made by detecting the renal tumour, which is often unduly mobile. Skiagrams reveal the enlarged kidney and sometimes its cause—*e.g.*, ureteric stone. Intravenous pyelography will prove the nature and extent of the dilatation and establish the integrity of the other kidney. Neither intravenous nor ascending pyelography is free from risk if advanced bilateral hydronephrosis is suspected.

Treatment.—This should always be directed to the cause whenever it can be discovered. If there is a stricture or valve at the junction of pelvis and ureter, a plastic operation may prove successful. Aberrant arteries can usually be divided between ligatures, but complete relief does not always follow this, even if combined with a plastic operation on the dilated renal pelvis. In many cases nephrectomy is the only legitimate course, especially when the tumour is large and the other kidney healthy. Bilateral lesions may require temporary nephrostomy to avert uræmia, pending treatment of the original obstructive cause. Operations on the lumbar sympathetic have been recommended for the relatively common type presumed to be due to neuromuscular inco-ordination of preteric peristalsis.

Idiopathic megaloureter, which is usually bilateral, may be due to causes similar to those of Hirschsprung's disease (*q.v.*), and is amenable to cure by presacral neurectomy.

Renal and Perirenal Inflammatory Diseases.—Infection may reach the kidney (1) by ascent from the lower urinary tract; (2) from the blood stream; (3) by direct extension from a neighbouring viscus. According as the main stress of the infection falls on the pelvis of the kidney or on the parenchyma the terms *pyelitis* and *pyelonephritis* are respectively employed, but these conditions are not always strictly delimitable. If infection is associated with urinary obstruction and dilatation of the kidney, a *pyonephrosis* follows; if, on the other hand, of the ascending type, the organism probably travels in the ureteral and periureteral lymphatics and not *via* the actual lumen of the duct. Hæmatogenous infections are probably the commonest; it may even be that what are termed ascending infections in fact reach the kidney not directly, but *via* the blood stream. During the course of infective diseases micro-organisms are excreted, sometimes in great numbers, in the urine, and even during health there is reason to suppose that from time to time pathogenic organisms are filtered out from the blood by the kidneys. If the latter are

already the seat of disease, there is a greater likelihood of such organisms gaining a foothold. The bacteria responsible are those commonly found in pyogenic disease elsewhere, but the *Bacterium coli* has a special importance in connexion with pyelitis, and organisms of the proteus group are more frequent in renal infections than elsewhere.

1. **Pyelitis.**—Here the renal pelvis, calyces and more or less of the ureter are involved. The mucous lining is swollen and reddened, sometimes showing small petechial hæmorrhages and often covered by muco-purulent discharge. Any traumatic or infective lesion of the urinary tract is a predisposing factor, the right kidney being more often involved, but in most cases no definite cause is discoverable. Women are specially susceptible during the latter months of pregnancy, when there is a tendency to obstruction of the ureter by the uterus at the pelvic brim.

Signs and Symptoms.—Sudden pain in the loin, frequency of micturition and pyrexia are often associated with repeated chills and severe toxæmia. The urine is acid and usually turbid from the presence of pus and micro-organisms, but occasionally it is clear. Cystoscopically an inflamed, swollen ureteric orifice is the rule, and the effluents from it may be turbid from admixed pus, though this is not invariably apparent.

Treatment.—All possible mechanical sources of obstruction or infection such as stricture, enlarged prostate or stone must be removed. Abundance of fluids, and adequate doses of alkalies should be given for a fortnight, followed by hexamine and ammonium chloride to acidify the urine. In serious or intractable cases a *ketogenic diet* is advisable.

To obtain the best results from the latter method it must be rigidly adhered to, but if properly carried out it will help in the cure of many cases of pyelitis, in addition to other varieties of chronic infection of the urinary tract. Usually it is desirable to give from 225 to 275 grammes fat; protein 0.3 gramme per pound of body weight; carbohydrate 15 grammes daily. Ketosis should develop in three to five days,

but it should not be maintained uninterruptedly for more than two to three weeks at a time. For pyelitis, treatment often needs to be prolonged. It is necessary to keep the urine acid with ammonium chloride or nitrate given by the mouth every six hours. The rationale is that under this régime the urine contains β -oxybutyric acid, which is bactericidal. Persistence of symptoms is often due to the failure of the urine to become ketonuric in spite of dieting.

Mandelic acid, sodium mandelate and nitro-hydrochloric acid are all useful in *Bact. coli* pyelitis, since they all lower the pH value of the urine markedly.

Sulphonamide therapy has proved of great value in these infections and bids fair to replace older methods. Nephrectomy is sometimes necessary in unilateral cases, should the suppurative condition spread rapidly to the renal parenchyma. Lavage of the renal pelvis is occasionally desirable.

2. **Pyelonephritis.**—Multiple abscesses are found disseminated throughout the renal parenchyma, and the pelvis shows the changes of pyelitis, often with areas of ulceration in addition. The pyramids frequently show yellow streaks, due to the purulent content of the tubules, and the whole kidney is congested and enlarged. Eventually the smaller abscesses coalesce to form large cavities, and the perinephric tissue often becomes oedematous and later the seat of suppuration. The condition is particularly liable to follow instrumentation in cases of long-standing urethral stricture, enlarged prostate, etc., the condition being often termed *catheter fever*.

Signs and Symptoms.—The onset is acute, with high fever, often with rigors, lumbar pain, vomiting, extreme dryness of tongue and throat, delirium and coma. In the earlier stages micturition is painful and frequent, the urine is diminished and loaded with albumen, pus, blood and micro-organisms. Many cases die of uræmia, others may appear to subside, but there is a great tendency to recurrence, or for *chronic pyelonephritis* to supervene, associated with a dull leaden complexion, wasting, loss of appetite, and eventually chronic uræmia and death.

Treatment.—The cause should, if possible, always be treated, but if this involves any extensive operation it is better to adopt measures which aim at drainage of one or both kidneys proximal to the site of obstruction. This necessitates suprapubic cystotomy in many cases, and in others nephrotomy on one or both sides. Diuresis by abundant fluids, hot packs, hot-air baths, dry cupping to the loins, and drastic purgatives such as jalap, may occasionally prove helpful.

3. *Pyonephrosis.*—This is usually the result of obstruction to the outflow from the ureter in cases of pyelonephritis or pyelitis, and is common in association with calculi; there is also a special tuberculous type (*q.v.*). Pyonephrosis may develop in a hydronephrotic kidney, in which case the renal dilatation may be enormous. The secretory tissue becomes destroyed by ulceration and abscess formation, and the ureter wall is frequently greatly thickened. Early involvement of the perinephric tissue is the rule, with fixation to the muscles, great vessels and duodenum, thus rendering operation difficult and hazardous.

Signs and Symptoms.—A tender, fixed and enlarged kidney can be felt, in association with pyrexia and the other features of pyelonephritis or pyelitis. Occasionally the ureter is blocked and the pyonephrosis is then 'closed,' but this is often only temporary, except in certain forms of tuberculous pyonephrosis. Skiagraphy and cystoscopy are necessary for localization of the pyonephrosis, to assist in determining the cause and to establish the condition of the other kidney.

Treatment.—Removal of the obstructive factor, whenever possible, must precede direct assault on the kidney. Drainage (nephrostomy) is indicated when the pyonephrosis is of huge size or the patient's condition unsatisfactory, but for radical cure nephrectomy by the lumbar route is advisable.

4. *Renal Abscess.*—This, in addition to being frequent in association with the infective conditions described above, may occur during the course of septicæmia or pyæmia, when it is secondary to a

septic infarct. (A somewhat similar condition, *renal carbuncle*, has also been described, in which there is an extensive local gangrene of renal tissue.) Perirenal infection is liable to complicate renal abscess. Nephrostomy is indicated, but nephrectomy cannot always be avoided.

Perinephritis and Perinephric Abscess.—In association with inflammatory and atrophic changes in the kidney, a large enveloping mass of fibro-fatty tissue is often formed. It gives rise to pain, flexion of the thigh, and often to scoliosis without involvement of the hip or other joint (non-suppurative type). More important surgically is the *suppurative type*, in which, following an infection of the kidney, and sometimes apparently independently of renal involvement, the perinephric tissues become the seat of a suppurative process. From what is known of the frequency with which small septic infarcts form in the kidney in a great variety of infective and suppurative diseases, it is probable that most, if not all, perinephric abscesses are primarily of renal origin. It is usual, however, to describe cases due to invasion of the perinephric space from appendicular or biliary suppuration, or *via* the blood stream from boils, whitlows, etc. Pus may track a considerable distance and burst into colon or lung, or present in the costo-vertebral angle, buttock or groin. A high swinging temperature and malaise may precede localizing symptoms by several weeks. Eventually pain in the loin, bulging behind the kidney and, finally, œdema and fluctuation below the last rib external to the erector spinæ, enable the diagnosis to be made. Treatment is by free incision in the posterior part of the loin and drainage. Associated renal disease may necessitate nephrotomy or nephrectomy, but these are generally better postponed.

Renal Tuberculosis.—Occurs more commonly in women and is usually at first unilateral. It is almost invariably part and parcel of a more widespread tuberculous infection of the genito-urinary tract, but the kidney lesion may overshadow the other manifestations. Tuberculous lesions elsewhere—*e.g.*, pul-

monary—are very common, but may appear to be entirely quiescent. On the other hand, the renal condition may be secondary to active pulmonary tuberculosis, Pott's disease, etc. It is usual to describe ascending and hæmatogenous forms of renal tuberculosis, but there is little evidence that the former occurs, and it is probable that in all cases the infection is blood-borne. Strict localization to one kidney is commoner in women; in men, even in unilateral cases, lesions of the bladder, prostate or epididymis often coexist.

Renal miliary tuberculosis is of no surgical importance, but there are two commoner pathological types: (1) *Ulcerocaseous*, beginning in the pyramids and spreading outwards, so that by the time the capsule is reached there is extensive cavitation within the kidney substance. The perinephric tissues may be involved, and sooner or later the pelvis and ureter. (2) *Tuberculous pyonephrosis*. Here the ureter becomes obstructed early and the kidney enlarges, its surface often becoming markedly lobulated.

Signs and Symptoms.—Frequent and painful micturition is often the initial symptom, followed by polyuria (especially at night). The urine is acid, contains a little pus, and blood may be present in microscopic amounts only, though gross hæmaturia is not infrequent and may be the initial symptom. Pyrexia may be absent, or trivial and intermittent, but if other parts of the genito-urinary tract are involved, it is often severe and persistent. Renal colic, indistinguishable from that associated with the passage of a stone, may occur when caseous material passes into the ureter, but fixed renal pain is far commoner. Loss of weight and strength are pronounced if the disease is active. In rare cases extensive caseation and distension of the kidney may occur insidiously without other signs or symptoms. This favourable type is called *closed tuberculous pyonephrosis*.

Diagnosis.—The discovery of tubercle bacilli in the urine of a patient who has pyuria or hæmaturia indicates renal tuberculosis. Repeated examinations are frequently necessary before the organism is

recognized, and cultural tests by Saenz's method as well as the guinea-pig inoculation test may be required in doubtful cases. The vital issue is to determine whether the disease is unilateral or bilateral; a grossly tuberculous kidney may not be palpable or tender, whereas tenderness and enlargement of the kidney on the healthy side may be due to compensatory hypertrophy. Pelvic examination may reveal a thickened ureter on one side. Cystoscopy may show definite localization of tubercles, ulcers, or bullæ to the region of one ureteric orifice, though this is not invariably so. The bladder is usually smaller than normal. Sometimes in very chronic cases the ureteric orifice may be rigid, distorted or excavated. Ascending pyelograms may reveal early lesions. If doubt still remains, the urine must be collected from each ureter separately and tested for tubercle bacilli. In all cases in which the disease is considered to be unilateral, the functional capacity of the supposedly healthy organ must be estimated. Skiagrams may reveal gross caseous tuberculosis of the kidney in the absence of urinary changes. Discovery of foci of tuberculosis in the testicles, prostate or vesiculæ seminales will often indicate the nature of an otherwise doubtful renal lesion.

Treatment.—In unilateral lesions nephro-ureterectomy is indicated, the whole length of the ureter being excised, with the kidney and its perinephric fatty capsule. If the testicle and the vesiculæ seminales are involved, they should be removed at a later date. In all cases in which nephrectomy is contra-indicated by active pulmonary disease, etc., the patient should be placed under sanatorium treatment. Tuberculin is specially valuable in genito-urinary tuberculosis.

Renal Calculus.—The kidney is the main source of urinary calculi. The following are the main etiological factors:

1. **Extrinsic Factors**—(a) *Generalized Osteitis Fibrosa Cystica*.—Here the parathyroid adenoma causes mobilization of skeletal tissue, the serum calcium is

raised and the urinary calcium greatly increased.

Renal calculi occur in nearly 50 per cent. of the cases.

(b) *Fractures and Certain Bone Diseases*.—Osteomyelitis, tuberculosis, fracture of the spine and femur, and of other long bones, simple and compound, may be followed by renal lithiasis. Rest and recumbency tend to increase this tendency.

(c) *Dietetic Influences*.—Deficiency of vitamin A in the diet favours lithiasis, and *vice versa*.

(d) *Cystinuria*.—The abnormal sulphur oxidation in this disease leads to cystine calculi in kidneys, etc. Most cases occur in males, and a familial tendency is frequent.

2. *Intrinsic Factors*—(a) *Urinary Colloids*.—The capacity of the urine to keep urates and oxalates in solution is due to the 'buffer' action of the urinary colloids. Deficiency in normal colloids or advent of abnormal colloids leads to deposit of crystals, though excessive output of crystalloids may be an added factor.

(b) *Abnormalities of the Urinary Tract*.—Foreign bodies, obstruction, stasis, and infection are all possible factors in urinary lithiasis.

Renal calculi are usually unilateral, though there is a tendency for the second kidney to be involved later. Men who lead sedentary lives are specially liable to the disease, and there are certain localities—e.g. India, Central Russia, and in England, East Anglia—where it is prevalent.

These calculi have a nucleus of ammonium urate (children), uric acid (young adults), or calcium oxalate (older patients), with a laminated structure at the periphery; the laminæ consist of calcium oxalate or uric acid usually, but calcium carbonate and triple phosphate are also met with. Stones consisting of one chemical substance are rare; mixed calculi are the rule. *Calcium oxalate* stones are hard and dark coloured, the surface mammilated or covered with sharp crystalline spicules. *Uric acid* stones, which may be multiple, are hard, smooth and brownish in colour. *Ammonium* and *sodium urate* calculi are small, soft and buff-coloured. *Calcium phosphate*

calculi are greyish-white and hard with an irregular surface, but *mixed phosphatic* calculi are softer and paler. *Cystine* calculi are yellow or greenish, have a radiating structure and the cut surface feels slightly soapy. *Xanthine* calculi are smooth, hard and reddish-brown.

Signs and Symptoms.—Not infrequently renal stones are latent, especially when large, bilateral and filling the renal pelvis and calyces. Pain in the loin, increased by movement and relieved by lying down, is particularly characteristic of small irregular stones in the kidney pelvis, but *renal colic* is more intense. It is sudden in onset, radiates down the line of ureter to groin, testicle or tip of penis, is often accompanied by vomiting and frequent painful attempts at micturition, though only a few drops of blood-stained urine are passed. (It is specially to be noted that renal colic is far more frequent than is renal lithiasis.) Copious hæmaturia is not very common, but small quantities of blood can more often be detected. *The tendency of the bleeding to follow movement is characteristic.* Cystoscopy reveals a purulent or blood-stained effluent from one kidney, and the ureteric orifice is often œdematous and inflamed. Skiagrams will reveal the size and position, sometimes even indicating the chemical nature, of the calculus. Only the very rare small pure uric acid stone is translucent to X-rays. Infantilism may result from bilateral renal lithiasis in children.

Complications.—(1) Migration into ureter or bladder. (2) Obstruction causing hydronephrosis or, if bilateral, calculous anuria. (3) Infection—*e.g.*, pyonephrosis and perinephric abscess.

Diagnosis.—A calculus may have been passed previously, or the urine be found loaded with crystals. The effect of movement on the pain and hæmaturia is significant, for both the local pain over the kidney and the severe radiating pain of renal colic may be simulated by renal infection, oxaluria, etc. Skiagrams reveal all except pure uric acid stones, those containing large amounts of oxalate or phosphates being most readily detected. The pas-

sage of an opaque catheter and pyelograms help to exclude such extra-renal shadows as gall-stones, calcified glands, etc.

Treatment.—Renal colic is controllable by rest in bed, with morphine and atropine hypodermically. Hæmaturia, if severe, will need in addition 5 c.c. of 10 per cent. calcium chloride intravenously once or twice daily. A low protein diet is essential in cystine calculi if recurrence is to be avoided.

Operation is advisable, except in certain bilateral cases with defective renal function or when, in spite of the frequent passage of small stones, no shadow can be detected in kidney or ureter.

1. *Pyelolithotomy.*—The calculus is removed through an incision in the posterior wall of the renal pelvis. This route is ideal for small or moderate-sized stones, the removal of which is possible without damage to the renal pelvis, since it avoids the risk of post-operative hæmorrhage. Pyelolithotomy cannot be performed unless the kidney is mobilizable.

2. *Nephrolithotomy.*—This must be employed for large branched stones or for those remote from the pelvis. The use of the diathermy knife is advantageous. It may be necessary to split the parenchyma widely to allow of the extraction of large calculi, and in this event resuture of the kidney is associated with the risk of recurrent or of secondary hæmorrhage, which may be sufficiently severe to require an emergency nephrectomy. Temporary nephrostomy is often advisable.

3. *Primary Nephrectomy* is indicated: (1) If the kidney is a mere shell of atrophic tissue with extensive suppuration; (2) when calculi are so numerous and widespread as to preclude the possibility of their complete removal without destroying the kidney function.

4. *Secondary Nephrectomy* is called for: (1) If urinary fistula persists; (2) when recurrent severe hæmaturia follows removal of the calculus; or (3) should calculi rapidly recur.

Calculous Anuria.—This condition, commoner in middle-aged men, is due to sudden obstruction of

the ureter, generally at its upper end, by a small calculus, the remaining kidney being either wholly or partly functionless from disease, atrophy or extirpation. Occasionally the ureters of both kidneys become simultaneously obstructed, or the unobstructed kidney may cease to secrete by some form of reflex action.

Signs and Symptoms.—The onset may be sudden with renal colic, or quite insidious and painless. The affected kidney is tender and enlarged, and the abdominal muscles rigid. The obstructing calculus, if low down, may be palpated per vaginam or per rectum, or its presence may be suggested by ecchymosis at the ureteric orifice seen cystoscopically. It is usual to describe two phases in the course of the disease.

1. *Tolerant Stage.*—This lasts about a week, but sometimes considerably more. There is either complete anuria, or oliguria with occasional polyuria. Later on there is nausea, headache and constipation.

2. *Toxic Stage.*—This supervenes on the former. The patient passes into delirium or coma, with muscular twitchings, slow or Cheyne-Stokes respiration, subnormal temperature, hiccup and vomiting.

Diagnosis.—The history will often suggest calculous disease, while skiagraphy and cystoscopy will usually enable other forms of anuria to be excluded. The obstructed kidney must be differentiated from the atrophic or nephritic one by the rigidity of the abdominal muscles, and if necessary by ureteric catheterization, though all forms of instrumentation should be reduced to a minimum in this condition.

Treatment.—Diuretics should be pressed, a pint or more of 2 per cent. sodium chloride with 5 per cent. glucose given intravenously, and purges, hot packs and pilocarpine administered. As soon as possible the obstruction should be relieved by the most straightforward method available. A simple nephrostomy is advisable if the obstructive factor cannot be localized, or when its removal would entail a prolonged or difficult operation. Occasionally the stone is passed spontaneously before operative measures

are instituted, but this happy result should not be anticipated.

Ureteric Calculus.—As already premised, the kidney is the usual source of ureteric calculi. The site of impaction is either (1) within an inch or two of the upper end of the ureter, (2) near the pelvic brim, or (3) within the terminal 2 inches. Though commonly small, it may by accretion *in situ* reach an enormous size and occupy the greater part of the length of the ureter. The more irregular the stone, the greater the likelihood of impaction; thus it follows that ureteric stones are usually composed of oxalates or phosphates. The obstruction caused by a ureteric calculus is seldom complete, but in that event atrophy of the kidney may follow. In most cases, owing to the intermittence of the occlusion, hydronephrosis follows unless, as so often happens, the stone moves on in stages and reaches the bladder.

Signs and Symptoms.—These closely resemble those of renal calculus, but there is a greater tendency to severe pain of the colicky type, radiating downwards into the groin, testicle and penis. The pain is noticeably lower down as the stone advances, finally producing intense strangury, with the passage of small amounts of blood-stained urine, just before the final escape into the bladder, when pain for the time being ceases.

Diagnosis.—By pelvic examination under favourable conditions a calculus may be palpable. Skia-grams show an opacity in the line of the ureter. This shadow is often vertically elongated and must be distinguished from that due to a phlebolith, calcareous artery, calcified tuberculous gland or a coprolith. This may be done by the features given above and by the passage of an opaque ureteric catheter, which, whether it is arrested by the calculus or slips past it, clearly reveals the site and nature of the opacity. Cystoscopically the calculus may be seen actually projecting into the bladder, but more often there is œdema and intense congestion around the ureteric orifice.

Treatment.—If the calculus is moving downwards,

and the urine sterile, it is justifiable to wait several weeks in the hope that it will be passed, especially if the kidney on the other side is healthy. Diuretics and antispasmodics such as belladonna and Ammi Visnaga should be administered throughout the expectant period. If skiagraphic evidence shows that the calculus is not moving but is firmly impacted, it should be removed by an extraperitoneal route, preferably through a paramedian incision. Usually it can be induced to pass after dilatation of the ureteric orifice and instillation of olive oil into the ureter, or, when projecting into the bladder, may be extracted through an operating cystoscope. Stones of moderate size can often be induced to pass, after distending the renal pelvis with saline, through a catheter which has been kept *in situ* for forty-eight hours previously.

Renal Neoplasms—1. Innocent.—Are all rare and mostly unimportant, except those obstructing the renal pelvis. An adenoma may occur in the sub-capsular region; it is pale pink in colour and rarely larger than a cherry. Papillary and tubular varieties are described.

Papilloma of the Renal Pelvis.—This growth resembles closely a papilloma of the bladder, and like it, frequently in its later stage becomes malignant. Obstruction to the ureter, with pain, hæmaturia, tendency to hydronephrosis or pyonephrosis and calculus formation, characterize the condition. Seeding of the tumour to the ureter or bladder may enable detection by the cystoscope, and pyelograms will reveal a suspicious filling defect in the renal pelvis. Treatment is by nephro-ureterectomy. *Angioma of the renal pelvis* produces painless hæmaturia and should be treated by exploration of the kidney with local destruction of the tumour by diathermy. As this counsel of perfection is seldom attainable, owing to the small size or obscure position of the nævus, nephrectomy may be called for.

2. Malignant.—The *renal pelvis* is very rarely the site of primary malignant tumours. Of these, epithelioma is the least rare, but sarcoma and rhab-

domyo-sarcoma are described. Primary malignant epithelial growths of the ureter are known. The signs and symptoms closely resemble those of the innocent growths mentioned above. The *renal parenchyma* produces growths with histological characters which render exact classification difficult, and many anomalous forms occur. It is usual to describe three groups.

(1) *Sarcoma (Wilms's)*.—This is common in children under five. Histologically, the cells are polymorphic and rapidly growing. The tumour may become enormous, sometimes the second kidney is affected, and widespread metastasis is the rule. Some of these tumours are radio-sensitive. Sarcoma in adults is rare, but also polymorphic in cellular structure and, like that in children, in certain respects resembles a teratoma. It is, however, always unilateral, but disseminates widely.

(2) *Carcinoma*.—This rare tumour is one of adult life. There are two types: (a) papillary adenocarcinoma; (b) alveolar carcinoma. Many of the former are confused with hypernephroma (Grawitz's tumour), and there is still much uncertainty as to whether the latter should not be considered a particular type of renal tubular carcinoma. Spread occurs by lymphatics and blood stream, and metastases are therefore often remote and sometimes in bones.

(3) *Hypernephroma*.—It is at present the custom to classify about 70 per cent. of malignant renal neoplasms under the term first employed by Grawitz. It arises in the cortex of the kidney, and eventually projects from its surface, often encroaching on the pelvis. Solid, with distinct yellowish or brownish areas, it often undergoes hæmorrhagic degeneration, and cyst formation is not uncommon. A false encapsulation is usual, but the growth is malignant, though the rate of spread is very variable. Metastasis is chiefly through the blood stream, but the local lymphatic glands may be invaded, and occasionally also Virchow's gland above the left clavicle. Secondary deposits in bone are characteristic, but they may also occur in the lungs and other remote parts.

Signs and Symptoms.—1. *Hæmaturia*.—This is almost a rarity in the renal sarcoma of children, but is the rule in all other forms of malignant renal neoplasm. It is most noticeable when the growth has penetrated into the pelvis of the kidney. It is painless, intermittent and, unlike that due to calculi, independent of movement. If ureteric clots form, renal colic may supervene.

2. *Pain*.—In addition to the colic just mentioned, dull aching pain in the loin is complained of as soon as the growth extends beyond the renal capsule. Eventually, extension to lumbar nerves may determine pain of a widely radiating character.

3. *Renal Tumour*.—This is the commonest feature in children, but it is not easily detected in the adult until of large size. Obstruction of the spermatic vein on the right side by a solid mass of growth invading the vena cava may cause an acute varicocele, and this, if it occurs, is of almost diagnostic value. Cystoscopy reveals the side of origin of bleeding during the stage of active hæmaturia, and pyelograms by the ascending or descending method will usually show a characteristic filling defect (see Fig. 54).

Treatment.—If metastases can be excluded, removal of the kidney by the abdominal route, with as much of the perinephric fascia as possible, is the only proper course. Irradiation should be used as an adjunct.

Renal Cysts.—Excluding hydronephrosis, which is in a special category, the kidney may be the seat of the following types of cyst:

1. **Multiple Cysts.**—Usually small and associated with chronic nephritis.

2. **Dermoid Cysts.**

3. **Polycystic Kidney.**—A congenital bilateral abnormality, which sometimes affects members of a family. It is due to failure of fusion of the mesoblastic and epiblastic elements in the kidney, and the stage at which symptoms appear possibly depends on the extent of this failure. If widespread, the condition is noticed at birth or in infancy, and the child soon succumbs. If less extensive, it is com-

patible with survival to, or beyond, middle age. In one-fifth of the cases cystic changes coexist in the liver, and sometimes in other organs—*e.g.*, pancreas, ovaries, etc. The renal cysts vary greatly in size and contain clear yellowish or brown turbid fluid, in which desquamated cells, casts, blood cells, and sometimes crystals of uric acid or oxalate may be found.

Signs and Symptoms.—Extremely large polycystic kidneys in the child may impede labour. In adults symptoms are obscure, but eventually the enlarged kidney is detected, and later indications of chronic uræmia appear. Almost invariably bilateral, one kidney may be so much the larger that the abnormality on the other side is overlooked. Slight intermittent hæmaturia, alternation of polyuria and oliguria, lumbar neuralgia with rigidity of the overlying muscles may occur from time to time, and finally the amount of urine passed diminishes to vanishing point.

Treatment is called for only in case of unilateral pyonephrosis, which is not uncommon.

4. **Solitary Cysts** are rare and unilateral, sometimes reaching a great size. They are surrounded by a smooth wall lined by flattened epithelium, and filled with pale amber fluid containing albumen, salts, and traces of urea. They produce aching pain when large and, while having the character of a renal swelling, cause no deformity in a pyelographic shadow. The proper treatment is extirpation of the protuberant wall of the cyst, the remainder being destroyed by coagulants or diathermy. Nephrectomy is seldom called for.

5. **Hydatid Cysts** have the characters of this parasitic disease elsewhere, and similar diagnostic methods are necessary. There is a tendency for them to burst into the renal pelvis, or for the daughter cysts to enter the lower urinary tract, where they may be detected in the urine. They may also rupture into the abdominal or thoracic viscera, and give rise to grave complications.

Treatment is by extirpation of the cyst wall after sterilization by formalin injections, followed by

marsupialization. Nephrectomy may be inevitable in certain cases.

Suprarenal Neoplasms.—Hyperplasia or adenoma of the suprarenal cortex may be associated with sexual abnormalities. In the male, the 'infant Hercules' type results; in the female, hirsutes develop, the voice and manner change, and a masculine appearance is assumed, all of which phenomena may disappear after successful extirpation of the tumour.

Diagnosis may be made not only by the sexual changes, but by the downward displacement of the kidney revealed by skiagrams and pyelograms.

Treatment.—These tumours are sometimes removable. The best approach is an abdominal one, for by this it is often possible to avoid damage to the kidney, but it may be necessary to divide the rectus and oblique muscles extensively. Some prefer the transdiaphragmatic route.

In *pheochromocytoma*, paroxysmal attacks of high blood pressure with intense headache are highly characteristic; the paroxysms are associated with cramps in the limbs, colicky or anginal pain, mydriasis, dyspnœa, pallor, headache and sweating. During the crises the systolic pressure alone is affected, and there is an associated rise in the blood sugar with glycosuria; both these points are of value in differential diagnosis.

Neuroblastoma occurs in infancy or childhood and tends to metastasize to the cranial bones near the orbit, and to the viscera. Two clinical types are recognized:

1. Pepper's tumour, which usually affects the right adrenal, and produces a highly enlarged liver in which an enormous number of minute metastases can be discovered.

2. Hutchison's tumour. Here the secondary deposits occur in and near the orbital region, and there is no special localization of the primary tumour to the right adrenal.

Treatment.—In exceptional cases, these neoplasms are amenable to surgical removal, but unfortunately most of them have invaded the inferior vena cava before the diagnosis is clear.

CHAPTER XLII

**AFFECTIONS OF THE BLADDER, PROSTATE
AND VESICULÆ SEMINALES****THE BLADDER**

Congenital Abnormalities.—1. **Extroversion of the Bladder or Ectopia Vesicæ.**—This rare condition results from a failure of development of the allantois, so that the anterior wall of the bladder and parts of the overlying abdominal wall and pubic bones are defective; the posterior wall of the bladder bulges forward into the resulting gap. The umbilicus is absent, the exposed vesical mucosa below it, being subject to constant friction, is usually unduly vascular and often covered with soft, easily bleeding warty growths; ulcers develop and phosphatic deposits arise from decomposition of the urine, which can be seen to spurt from the exposed and often dilated ureteric orifices. In the male, in which sex the anomaly is commoner, the penis is small, has a dorsal gutter representing the urethra (epispadias), and the testes are rarely properly descended. Ascending infection of the urinary tract eventually supervenes, with death from uræmia consequent on pyelonephritis or pyonephrosis.

Treatment.—The ureters are transplanted one at a time into the pelvic colon, by the transperitoneal route. It is desirable to wait until the child is at least four years old before attempting this. At a later date the bladder can be excised and the gap in the abdominal wall repaired. In favourable cases the patient is enabled to retain the urine in the rectum for some hours at a time, and to survive in comfort for many years. Numerous other plastic operations have been adopted, but as they at best afford slight relief only, they have been abandoned.

2. **Persistent Urachus.**—This is due to failure of the allantois to become converted into a solid cord. Urine may escape from the umbilical region, but

seldom in quantity unless there is an associated urethral atresia, which in such cases needs to be treated at once. The open urachus can be cured by removal, after dissecting it back to the bladder. If the lower end only of the urachus persists, a diverticulum of the bladder forms, in which a calculus may develop. If the intermediate portion alone is patent, a *urachal cyst* forms. It should be removed to avoid the danger of malignant disease, which is not unknown.

Rupture of the Bladder.—Rupture follows, especially when the bladder is full, from falls, blows, kicks and forcible contact with the pommel of the saddle in hunting accidents. The injury is often associated with fracture of the pelvis. A diseased bladder may rupture from instrumentation or irrigation. Two types are recognized:

1. **Intraperitoneal.**—Here the tear is usually situated postero-superiorly and the urine escapes into the peritoneal cavity, peritonitis supervening. Free fluid may be detected in the abdomen, there is shock, rigidity and pain in the hypogastrium and frequent desire to urinate, only a little blood-stained urine being passed. A catheter withdraws a few drops of fluid, but may occasionally be guided through the rent, and then its end can be palpated high above the pubes. A measured quantity of sterile saline introduced through a catheter fails to be returned in equal bulk.

Treatment is by immediate laparotomy, with careful closure of the rupture after excision of grossly damaged tissue. The peritoneal cavity is emptied by some form of suction apparatus, and drained if necessary by a tube in the recto-vesical pouch; a self-retaining catheter is then tied into the bladder.

2. **Extraperitoneal.**—This is the type commonly associated with fractured pelvis. The urine escapes into the space of Retzius and spreads upwards, downwards and backwards, leading to a virulent pelvic cellulitis associated with high temperature, profound toxæmia, an indurated suprapubic swelling, and sometimes œdema of the scrotum and perineum. If the rupture is small, part of the urine may be retained in

the bladder and a catheter withdraws urine mixed with blood. The introduction of sterile saline aggravates the suprapubic pain and swelling, but a greater proportional volume of it is withdrawable than with the intraperitoneal type of rupture.

Treatment.—Free incisions for drainage are of more importance than repair of the rupture, but this should be performed when possible. A suprapubic cystotomy is essential and is often wisely combined with drainage per urethram.

Wounds.—Gunshot wounds are common in warfare, stab wounds are rare in civil practice. The bladder is sometimes damaged during operation for femoral or inguinal hernia, or during hysterectomy.

Signs and Symptoms.—Profound shock, lower abdominal pain, suprapubic tenderness, and ineffective attempts at micturition are present. Severe hæmorrhage may result from associated damage to pelvic vessels, and fæces or flatuc may present if the bowel is coincidentally injured. If the wound is extraperitoneal, the symptoms are slower in onset and may be trivial.

Treatment is based on the same principles as for rupture of the bladder, but in grave cases free drainage rather than prolonged attempts at repair of wounds is always to be preferred.

Foreign Bodies.—These may be introduced by the patient—*e.g.*, hairpins; or by the surgeon—*e.g.*, portions of bougies, drainage tubes, etc. Not infrequently ligatures of silk, thread or chromicized catgut ulcerate through the bladder wall after pelvic operations, and set up irritation or calculus formation. Gall-stones have occasionally been found in the urinary bladder.

Treatment.—In women, after dilatation of the urethra, the foreign body may be removable through a Kelly's tube. In men a small lithotrite or the forceps of an operating cystoscope can be used if the object is small. In all other cases a suprapubic incision gives the most direct and safest approach.

Cystitis.—This condition, commoner in women, is the result of infection by the pyogenic organisms,

which are often present in mixed cultures. *Bact. coli* and staphylococci are those most commonly associated, but *B. proteus*, streptococci, *Bact. typhosum*, gonococci and pneumococci are not unusually present. In acid urine, *Bact. coli*, *B. tuberculosis* and gonococci are found; in alkaline urine, staphylococci and *B. proteus* are usual. In chronic cystitis anaerobes are frequently met with. Virulent organisms may infect the bladder without predisposing factors, but as a rule, before the organisms which are so commonly found in the urine can produce cystitis, there is (a) obstruction to proper emptying of the bladder; (b) the presence of calculi or foreign bodies; (c) the coexistence of malignant growths; or (d) the absence of proper nervous control. The passage of instruments, even when carried out with aseptic precautions, may precipitate cystitis in patients rendered susceptible by one or other of the pathological conditions above mentioned. Acute and chronic forms are recognized, but there are numerous intermediate grades.

Signs and Symptoms—1. *Acute Cystitis*.—The mucous lining of the bladder, examined by the cystoscope, is engorged, especially in the trigonal region; small scattered hæmorrhages into the mucous membrane may be seen, the normal definition of the vesical vessels is obscured, while muco-purulent threads adhere to the bladder wall. Superficial erosions may follow or yellowish semi-translucent bullæ develop. In rare cases local or diffuse sloughing or gangrene of the mucous membrane may supervene, or extensive membranous deposits may form and be passed from time to time. Pain and frequent micturition are constant features, and in the severe cases incontinence may develop. The frequency is both nocturnal and diurnal, and pain may be not only local but referred to the thighs and abdomen. Pyrexia, with or without hæmaturia, is the rule, but is often absent unless the infection has spread to the kidneys. There may be complete retention of urine, especially in association with enlarged prostate. The condition usually clears up under appropriate treat-

ment. If it becomes chronic, it frequently indicates a source of obstruction or of reinfection.

2. *Chronic Cystitis*.—Infiltration of the deeper layers of the bladder wall is common, especially in tuberculous cystitis, with eventual spread to the perivesical tissue, which is, often sclerosed and increased in bulk. The bladder contracts so that its capacity is seriously reduced. Leucoplakic changes appear on the mucosa, and soft calculi form especially where sacculi are present. Pain is much less prominent than in acute cystitis, but the urine is loaded with foul pus.

Treatment.—Confinement to bed, liquid diet, and diuretics, in conjunction with some form of sulphonamide therapy, are indicated. If the urine is acid, potassium citrate and sandalwood oil should be exhibited; but if alkaline, acid sodium phosphate is indicated. To relieve pain and strangury, belladonna and opium are necessary, combined with hot fomentations and frequent warm sitz-baths. Bladder washes are contraindicated. When the symptoms are subsiding and the subacute stage is reached, urinary antiseptics such as hexyl-resorcinol, hexamine, boric acid or benzoate of soda, may be given a trial; and bladder irrigation should be instituted. If the urine is alkaline, a weakly acid douche can be employed; if acid, a dilute alkali—viz., 1 to 2 per cent. sodium bicarbonate—is to be chosen. Later, oxycyanide of mercury 1:5,000 to 1:1,000, potassium permanganate 1:10,000 to 1:5,000, or silver nitrate 1:10,000 to 1:2,000 should be substituted, always selecting weak rather than strong solutions in the earlier stages. In many cases relief is afforded by instilling 4 ounces of sterile liquid paraffin. In chronic cystitis the underlying cause must be treated, urethral or prostatic obstruction relieved or a tuberculous kidney excised with its ureter, before any headway can be made with the diseased bladder. Regular irrigation, either by a continuous or intermittent method, with the stronger antiseptic solutions above mentioned, may be alternated with the instillation of small quantities of 5 to 20 per cent. gomenol, 2 per cent. protargol, or

1 per cent. silver nitrate. Vaccine therapy has its advocates, but a rigid régime on a ketogenic diet is more likely to be beneficial (see p. 548).

Tuberculous Cystitis may be due to direct spread down the ureter from a tuberculous kidney, to infection by the urine which has descended from the kidney, or to invasion of the bladder from a tuberculous prostate, but it is never primary.

Signs and Symptoms.—Small superficial clearly-cut ulcers can be seen with the cystoscope, less frequently deep ulceration with oedematous granulations is found. The bladder tends to contract. Frequent micturition, at first diurnal, later also nocturnal, and tending gradually to increase, is associated with pain over the bladder and at the end of the penis. Polyuria is the rule and is due to the associated renal disease; the urine itself, in which tubercle bacilli can be detected, is pale and acid. The disease is slowly progressive, but secondary infection is the great danger, as it leads to ascending pyelonephritis.

Treatment.—Apart from radical operations to remove the source of disease in the kidney, ureter or vesiculæ seminales, it is wisest to avoid bladder irrigation or drainage. Small doses, viz., 1/20,000 mg. of tuberculin T.R., should be injected and gradually increased weekly up to 1/1,000 mg. Ultra-violet light therapy applied through special applicators is a valuable adjunct.

Bilharzia (Schistosomiasis) of the Bladder.—The causative trematode is reproduced in the portal vein and its tributaries, from which the parasites pass into the vesical and rectal walls, where the ova are produced. It is a disease of dwellers in Egypt and the East. Painless hæmaturia is the first symptom noticed, and cystoscopic examination at this stage may reveal the ova as small white spots surrounded by an area of hyperæmia, scattered over the mucosa. Later, extensive ulceration with bulky granulations develops, and secondary infection follows with painful frequent micturition, leading eventually to a state of intense misery from incontinence. Ascending infection of

the urinary tract is inevitable unless quickly brought under control. Weekly intravenous injections of antimony tartrate in doses of $\frac{1}{2}$ to 1 grain, up to a total of 20 to 30 grains, will usually result in cure.

Neoplasms—1. **Innocent**.—The only common benign neoplasm is papilloma, though myoma, myxoma, myo-fibroma and dermoid cysts have been described.

Villous Papilloma.—May be sessile or stalked, and minute or large enough to fill the bladder. Though slightly more common as a single tumour, it is frequently multiple. The usual situation is to the outer side of and behind the ureteric orifice, but there are numerous exceptions to this, and in the multiple variety the growths may be widely disseminated over the bladder mucosa. Microscopically, the tumours are composed of transitional epithelium on a fibro-muscular vascular supporting stem, which may be simple or elaborately branched. It is probable that 'seeding' occurs from the original tumour, and in this way multiple secondary growths appear. It is usual to classify these tumours as benign, but many of them belie this by becoming eventually of an infiltrating and frankly malignant nature.

Signs and Symptoms.—Painless recurrent hæmaturia, starting suddenly, lasting a few hours or days and equally abruptly ceasing, is the one characteristic of the disease. There may be long intervals between successive attacks of hæmaturia, indicating that these growths are often very slowly growing. Cystoscopically, the appearance is highly characteristic, the branches of the tumour showing as semi-translucent, pink, finger-like processes, which are soft and easily displaced by the instrument. Sometimes, especially after cystoscopy, a fragment of the tumour is passed per urethram, and its nature can be determined microscopically. Obstruction to urination may in rare cases follow the inclusion of part of the neoplasm in the internal meatus.

Treatment.—(1) The ideal method for small pedunculated tumours is *electro-coagulation* by means of an electrode passed through an operating cystoscope. Special forms of cystoscope may be necessary to

permit access of the electrode to papillomata near the internal meatus, and in any case repeated applications may be called for to complete the destruction.

(2) In multiple tumours, *extirpation after supra-pubic cystotomy* is preferable to prolonged attempts to destroy them with the electric current. The mucous membrane at the base of each mass must be excised and the resulting gaps sutured with fine plain catgut. Silver nitrate 4 to 6 per cent. must then be instilled to destroy any tumour cells.

(3) *Partial cystectomy* is the best method when the tumour is large and sessile, or if there are many tumours confined within a reasonable area. A comparatively large amount of the bladder wall can, however, be excised, combined if necessary with re-implantation of one ureter, without serious interference with the function of micturition.

(4) *Complete cystectomy*, preceded by bilateral transplantation of the ureters into the pelvic colon, is indicated in the rare cases in which there is little or no healthy bladder wall remaining.

2. Malignant—(1) **Malignant Papilloma.**—This is the type of neoplasm which develops from an apparently innocent villous papilloma, though on the other hand its malignant nature may be obvious from the outset. A sessile growth, with short fleshy villi, is always to be suspected of a malignant character. Microscopically, there is infiltration at the base of the tumour by the epithelial cells, and both lymphatics and veins may be invaded.

(2) **Nodular Carcinoma.**—This is usually sessile, irregular and nodular, with a necrotic surface. The muscular layer at the base is often deeply infiltrated.

(3) **Infiltrating Carcinoma.**—Flat plaques form with a raised nodular margin and an ulcerated surface, the bladder wall being extensively infiltrated. Histologically, it may present the characters of (a) squamous epithelioma with definite cell nests, (b) adeno-carcinoma beginning in the glands at the base of the bladder, (c) spheroidal-celled carcinoma. Carcinoma of the bladder remains localized for a considerable time, but eventually penetration into the perivesical space,

peritoneum, lymphatics, and finally lungs, liver and bones follows.

Signs and Symptoms.—Hæmaturia is the usual initial symptom and may be profuse and painless as in villous papilloma, but in the more malignant growths, unlike papilloma, frequency of micturition is a common accompaniment. Cystitis often develops relatively early. Pain is at first due to cystitis, but with spread of growth to other structures the pain may be referred along the sciatic nerve.* The urine may show macroscopic or microscopic portions of the tumour tissue, and soft phosphatic calculi are very apt to develop.

Diagnosis.—There are two types: (1) Beginning with hæmaturia; (2) resembling cystitis. Cystoscopy will reveal the nature of the disease, but it is important not to be deceived by phosphatic deposits which may obscure the tumour mass. Both in cystitis due to tuberculosis and to bilharzia, granulation tissue may be mistaken for a neoplasm unless the causative organism is discovered. Rectal and vaginal examination may reveal that there is involvement of extravesical structures.

Treatment.—Radical operation is indicated if the kidneys have escaped ascending infection and the patient's condition permits.

(1) *Partial Cystectomy* is the operation of choice, but is not feasible if both ureteric orifices are involved. Re-implantation of one ureter into the reconstituted bladder wall is often possible, after operation necessitating removal of portions of the trigone or ureteric orifice.

(2) *Complete Cystectomy.*—The ureters are transplanted in one or in two stages, according to the patient's condition, into the pelvic colon. At a later date the whole bladder is excised by a perineo-abdominal route, though in the female, and occasionally in the male, the entire operation can often be completed through a single laparotomy incision.

The results of these two operations are on the whole excellent. Inoperable cases may need permanent suprapubic drainage to relieve pain and hæmaturia. Radiotherapy with modern technique is advantageous,

but such operations as nephrostomy and ureterostomy give little or merely transient relief.

Vesical Calculus.—The mode of formation of calculi in the urinary tract has been described on p. 554. Vesical calculus is more often met with in men and children than in women. The *nucleus* often consists of an oxalate or uric acid stone which has passed down from the kidney, but a portion of blood clot, a silk ligature, a fragment of catheter, or any other foreign body may suffice. The *body* of the stone consists of layers of calcium oxalate, uric acid, phosphates, etc., which are deposited on the nucleus, and when urinary infection and decomposition follow, soft mixed phosphates are superadded as a *crust* on the surface. Mixed phosphate stones are particularly liable to develop in association with prostatic obstruction. Vesical calculi may be solitary or very numerous. They have the same chemical composition as renal calculi (see p. 554), but as might be supposed, they are more frequently spheroidal or ovoidal in shape. Phosphate stones develop rapidly, while oxalate stones are slowly growing. Calculi often form in diverticula, in which they may be firmly grasped, and they are common in association with prostatic enlargement and after prostatectomy.

Signs and Symptoms.—The possibility of stone in the bladder may be suggested by previous attacks of renal colic. Pain and frequency of micturition are the first symptoms, though in certain cases, even with large stones, these may be trivial or absent. The frequency is diurnal until cystitis supervenes; exercise has a striking influence by aggravating the severity of the symptoms. Pain is often referred to the tip of the penis at the end of the act of micturition. Hæmaturia is seldom copious, and usually the blood is bright red and passed at the end of micturition. Complete retention of urine may result from impaction of the stone in the internal meatus, or sudden cessation may be followed by resumption of the stream. Incontinence of urine is met with in children, or attacks of screaming during micturition, and in small boys, attempts to relieve the pain in the penis

may result in a striking degree of congestion of the semi-erect organ. Rectal examination often reveals the stone in children, but in adults it is seldom possible to feel the calculus, except when large, either by rectal or vaginal palpation. Cystoscopy, unless the bladder is contracted, is the most valuable means of diagnosis, since it allows of an estimate being made of the size and number of the calculi and of their position, also the detection of complicating lesions. The use of the bladder sound for diagnosis has diminished *pari passu* with the development of cystoscopic methods. Skiagraphy and cystography (after instillation of 20 per cent. sodium bromide solution) are also helpful diagnostic methods, the latter being valuable, since it gives 'negative shadows' of stones which are ordinarily not opaque to X-rays.

Treatment.—Small stones may sometimes be removed by the large evacuator used in litholapaxy. More often the following methods are required:

1. *Litholapaxy (Lithotrixy).*—The stone is crushed and removed at one sitting. A few ounces (4 to 5) of 1:5,000 oxycyanide of mercury solution are injected into the bladder, the lithotrite passed, its handle raised, the blades separated and the stone grasped and crushed. The lithotrite is replaced by Bigelow's evacuator and the fragments swept out. A catheter should be tied in the urethra for a few days. It is possible to use litholapaxy even for small children, but the method is contra-indicated in enlarged prostate or chronic cystitis, or when the stone is very hard, large or fixed in a sacculus.

2. *Suprapubic Cystotomy* is indicated in all cases deemed unsuitable for litholapaxy, for it has the great advantage of permitting treatment of associated vesical lesions. Its main disadvantage is the longer convalescence which is entailed.

Vesical Diverticulum.—A bladder diverticulum is a pouch lined by mucous membrane. If congenital, its wall is composed of fibro-fatty tissue with a little unstriped muscle, but if acquired the muscle is absent. Diverticula are single or multiple, small or large, but the characteristic feature of all is the well-

defined mouth, surrounded by an area of fasciculation of the bladder wall. The ureteric orifice is often close to the diverticulum, but only rarely does the ureter actually open into the pouch. Stagnation of urine in the diverticulum often results in cystitis, stone formation or malignant disease.

Signs and Symptoms.—The symptoms are rarely characteristic and may be entirely absent, but attacks of partial or complete retention of urine are common. Sometimes the patient passes clear fluid from the bladder, followed by turbid foul urine from the diverticulum, and the catheter may reveal a similar discrepancy. Cystography (preferably by a stereoscopic method) will reveal the size and position of the pouch, and if combined with cystoscopy the essential details are made available.

Treatment.—Palliative measures are of little value, but extirpation of the sac gives excellent results. It is essential to strip the peritoneum from the bladder extensively before opening the latter or attempting to define the wall of the pouch, which may be adherent to the great vessels and ureter and needs to be separated with great circumspection. In multiple diverticula partial cystectomy with ureteral reimplantation may be needed.

Fistula. Three types occur:—

(1) **Suprapubic Fistula.**—An uncommon sequel of prostatectomy; it can be cured by excision of the fistulous track, mobilization and suture of the bladder.

(2) **Vesico-Intestinal Fistula.**—This follows on a perivesical abscess, which later bursts into the bladder. Such abscesses arise in connexion with rectal ulcers, simple or malignant, appendicitis and especially diverticulitis of the pelvic colon.

Signs and Symptoms.—The opening into the bladder is small and as a rule far back and high up, the connexion with the bowel being rarely direct. Cystitis supervenes and pneumaturia (discharge of gas at the end of micturition) is characteristic of the condition. The amount of faecal matter which reaches the bladder varies greatly, but the urine frequently has a faecal odour; on the other hand,

urine may leak into the colon. Cystoscopically, the fistulous opening can as a general rule be seen, surrounded by an area of congestion or by bullous oedema.

Treatment.—It is to be borne in mind that many cases survive for years after the development of a vesico-colic fistula, and therefore operative treatment is to be reserved for patients who are vigorous. A preliminary colostomy is advisable previous to a direct attack on the fistula, unless as sometimes happens it heals spontaneously.

(3) **Vesico-Vaginal Fistula.**—This is usually a sequel to operation on the genital tract, or to injuries during parturition. The common situation for the vaginal orifice of the fistula is in the anterior fornix. De-composing urine escapes into the vagina and sets up irritation of the vulval skin. The exact course of the fistula is found by a combination of cystoscopy, cystography and vaginoscopy. Treatment demands complete separation of the walls of the apposed viscera around the site of the fistula, excision of scar tissue, reconstitution of the resulting gap by suture, and drainage of the bladder per urethram by a Sprengel's pump.

Functional Derangement of the Bladder.—Incontinence of urine or the involuntary escape of the bladder contents may be (1) *false*, the urine dribbling away from the overdistended bladder (retention with overflow), or (2) *true*, in which the bladder is not distended, but the urine either leaks away through a paralyzed sphincter (passive), or the bladder empties itself reflexly from time to time without the patient's volition (active).

Mechanical Incontinence.—This is more frequent in women, in many of whom, irrespective of child-birth, it may be present to a slight degree on coughing or straining. It more often follows parturition and is associated with the presence of a cystocele, which must be treated by a plastic operation. In the male, incontinence may follow perineal prostatectomy.

Nervous Incontinence.—This may be due to:

1. *Spinal Cord Diseases*—Organic disease of the

spinal cord—*e.g.*, tabes dorsalis—is the commonest source of this disability. In the early stages it is first noticed at night and is a false incontinence (*vide supra*), but later on the patient may regain some expulsive power, though there is always some residual urine. In disseminated sclerosis the bladder empties itself spasmodically.

TREATMENT.—The bladder should be catheterized three times in the day under the most rigid aseptic precautions, followed by irrigation with 1:5,000 oxycyanide of mercury lotion, and hexyl-resorcinol or hexamine exhibited.

2. *Spinal Cord and Nerve Injuries*.—Gunshot wounds or fracture-dislocations of the spine above the lumbar centres in the cord lead to immediate false incontinence, lasting about six weeks, followed by active or reflex incontinence, which persists unless the cord injury is recovered from. After excision of the rectum for carcinoma, damage to the sympathetic nerves may result in retention with overflow, followed by cystitis, unless special measures are adopted to drain the bladder, pending restoration of nervous control.

3. *Spasmodic Incontinence*.—In association with the intense spasm which accompanies acute cystitis, prostatitis and urethritis, and especially in tuberculous cystitis, active incontinence often develops, particularly at night. General sedatives (*e.g.*, morphine or atropine), warmth to the perineum (*e.g.*, by sitz-baths), and sandalwood oil internally are the methods to be relied on in treatment.

4. *Incontinence of Childhood—Essential Enuresis*.—The voluntary control of the bladder should be arrived at before the age of three. Enuresis is usually nocturnal, but may be diurnal, and both sexes are affected equally. A source of irritation—*e.g.*, thread-worms, vulvitis, phimosis, enlarged tonsils and adenoids—is by many indicted as the reflex cause of the abnormality, and in others the urine is either too highly acid or laden with irritating crystals. No such causative factor is discoverable in a large proportion of cases, which are then regarded as due to 'nervous irritability.' Fortunately, it persists in

few beyond puberty, but a small minority retain the habit into adult life.

TREATMENT.—All sources of irritation, direct or reflex, must be eliminated. In such cases as appear to be essentially nervous in origin, late hours and all forms of excitement are proscribed, fluids prohibited after 5 p.m., all stimulating drinks such as coffee and ginger-beer eliminated, and a milk-fruit-fish-vegetable diet ordered. The child must be trained to hold water as long as possible during the day, to empty the bladder before retiring at night, and means adopted to wake him after one to two hours' sleep. Belladonna should be given in gradually increasing doses, only stopping short of a toxic effect; it should be continued for a week or two and finally gradually omitted. Local treatment by 1 per cent. silver nitrate instillations into the prostatic urethra may be tried when all else fails.

Retention of Urine—1. *Obstructive*—This may be caused by: (a) Prostatic enlargement, simple or malignant, prostatic inflammation, abscess or stone; (b) urethral stricture, stone, injuries, foreign bodies or urethritis; (c) blood clot filling the bladder.

2. *Atonic*.—May be (a) associated with lesions of the spinal cord; (b) without demonstrable nervous disease (idiopathic).

3. *Toxic*.—Occurs in arsenic, mercury or lead poisoning, typhoid fever, appendicitis or syphilis, etc.

4. *Spasmodic*.—Found after operations on the anus or rectum and in hysteria.

Signs and Symptoms.—*Acute Retention*.—Usually complete and sudden in onset, it is associated with severe spasmodic bladder contraction and the viscus is full and tense.

Chronic Retention—Is almost always incomplete, the residual urine varying from an ounce or two to several pints. Enlarged prostate is by far the commonest cause, but it appears in injuries and diseases of the spinal cord. The distended bladder may be felt above the pubes, or in minor degrees a catheter withdraws the residuum. Frequency of micturition, with or without nocturnal incontinence,

is the predominating symptom and pain is absent. Chronic uræmia, from back pressure and damage to the kidneys, eventually supervenes in unrelieved cases.

Diagnosis.—Anuria must be carefully excluded, by noting that a catheter passes easily, but fails to tap urine. In atonic retention there is neither pain nor desire to micturate and a large catheter passes freely, whereas in obstructive retention special measures are necessary to enable the bladder to be emptied. In young men acute gonorrhœa is a common cause of acute retention, in middle age urethral stricture is most likely to be the source of the difficulty, and in old age prostatic enlargement is almost invariably responsible.

Treatment.—(1) Acute urethritis: Avoid the catheter, but try hot sitz-baths, morphine and hot enemata. If these fail, a soft rubber catheter should be passed. (2) Obstruction by stone, foreign bodies etc.: A catheter should be passed, if necessary after dilatation with metal bougies. (3) Blood clot filling the bladder must be broken up with a lithotrite, or after suprapubic cystotomy. (4) Enlarged prostate: Attempts should be made to avoid catheterization, by the use of morphine and hot sitz-baths. If these fail, a coudé or bicoudé catheter of moderate size should be passed under rigid aseptic precautions. No force must ever be employed, and when the instrument is successfully inserted the urine should be drawn off very slowly if there is much vesical distension. Suprapubic puncture or suprapubic cystotomy, with controlled decompression (using Kidd's U-tube), is necessary when the above measures fail. (5) Urethral stricture: The sedative measures already detailed under (1) should first be tried, but if they fail a fine catheter or bougie is passed. If the lumen is very small, a filiform or a Harrison's whip bougie is passed and fixed *in situ*. Urine begins to trickle past the indwelling bougie, and within a few hours a small catheter can usually be inserted. In the last resort, suprapubic puncture is always available.

Spasmodic retention calls for hot applications to the abdomen and injection of 'doryl' or 'esmodil.'

THE PROSTATE

Acute Prostatitis follows gonorrhœa or may be due to infection from contaminated catheters, or from the blood stream during the acute infective fevers, pyæmia, etc. The sequelæ are resolution, chronic prostatitis, or an abscess, and the latter may burst into the urethra or spread backwards and discharge into the rectum, leading to a urinary fistula.

Signs and Symptoms.—Frequent and urgent micturition with pain at the end of the act, a feeling of weight in the perineum, and painful defæcation are the rule. Pyrexia is usual, rigors rare. Per rectum the prostate is enlarged and tender, with areas of softening where suppuration has supervened. Complete retention of urine is by no means rare.

Treatment.—Absolute rest, purgatives, hot sitz-baths, fomentations to the perineum and hypodermic injections of morphine may be needed to relieve pain. A prostatic abscess may be drained through a transverse perineal incision.

Chronic Prostatitis.—This follows the acute variety, or may be incidental to a chronic urethritis. It is usually associated with vesiculitis.

Signs and Symptoms.—The prostate is enlarged and tender, there is a feeling of weight in the perineum, with frequent and sometimes painful micturition. There is a glairy urethral discharge, the urine containing threads of muco-pus.

Treatment.—Complete abstention from sexual intercourse and alcohol, with counter-irritation to the perineum, dilatation of the posterior urethra by bougies or special dilators and prostatic massage may in time effect a cure, but the condition is often most intractable. Transurethral drainage by electro-coagulation is often helpful.

Prostatic Calculus.—These calculi may form within the prostatic ducts, and then are usually multiple and small, consisting of calcium carbonate, phosphates and oxalates. They produce dense shadows

on skiagraphy, and should be removed with the prostate itself if they give rise to obstructive symptoms. Vesical or renal stones may become impacted in the prostatic urethra. They cause urinary retention, and are detected by rectal palpation, the passage of a metal sound or skiagraphy. It may be possible to displace such a calculus into the bladder and to treat it by litholapaxy (*q.v.*), but occasionally removal via a perineal incision is necessary.

Tuberculosis of the Prostate.—This is met with as part of a general infection of the genito-urinary apparatus and the prostate is seldom, if ever, the primary focus. It occurs in young adults who are predisposed by heredity and by antecedent gonococcal chronic prostatitis. Foci of caseous tuberculosis develop in the lateral lobes, where they can be palpated per rectum, and when liquefaction has supervened the abscess may burst into the urethra, bladder, or rectum.

Signs and Symptoms.—The condition is often extremely slow in its development and may produce trivial symptoms indistinguishable from those of chronic prostatitis, but pain, frequency, hæmaturia—especially at the end of micturition—and hæmato-spermia are often associated with it.

Diagnosis often necessitates the recognition of foci of tuberculosis in other parts of the genito-urinary tract. The nodules in the prostate are small and irregular, and the vesiculæ seminales are often enlarged and nodular. In advanced cases a fluctuating swelling can be felt per rectum.

Treatment.—Tuberculin T.R., combined with sanatorium treatment, is often of great value. Local applications are to be avoided and abscesses should be aspirated in preference to drainage. Only in very rare cases is it advisable to attempt extirpation of the diseased organ.

Prostatic Enlargement.—The causation of this is still obscure. It is very rare under fifty, and varies greatly in its rate of progress. The whole gland may be enlarged, or parts only may be affected, so that the swelling may be symmetrical or asymmetrical.

Histologically the changes may be (1) diffuse fibro-myomatosis; (2) localized fibro-myoma; (3) diffuse adenomatosis; (4) localized adenoma, it is doubtful whether simple prostatic enlargement is always neoplastic in nature.

Pathology—I. *Changes in the Prostate.*—Symptoms referable to prostatic enlargement may be found without any great increase in the size of the gland, in which

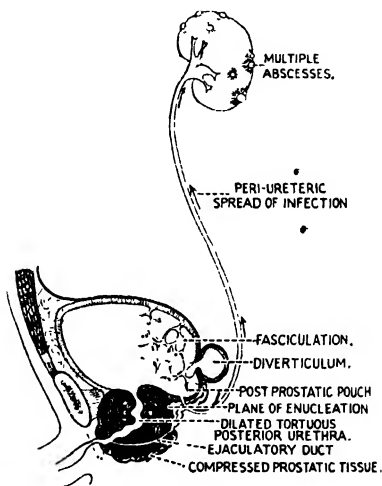


FIG 55 — ILLUSTRATING SIMPLE ENLARGEMENT OF PROSTATE AND ITS CONSEQUENCES.

Ascending pyelonephritis, diverticulum and fasciculation of bladder.

event it is usually very hard and fibrous. In most cases the increase in size is considerable and occasionally the gland may weigh several ounces. If the overgrowth is diffuse and symmetrical, there is some general rounding off of its contours; if asymmetrical one lobe may be considerably larger, with corresponding changes in the shape of the posterior

urethra. The prostate enlarges mainly in two directions: (1) Upwards and backwards, stripping off the vesiculæ seminales from the bladder wall. The part of the prostate below the ejaculatory ducts rarely takes any share in the enlargement. (2) Upwards and forwards, stretching the sphincter vesicæ and projecting into the bladder, either in the form of a horseshoe-shaped or 'collar-like' projection or,

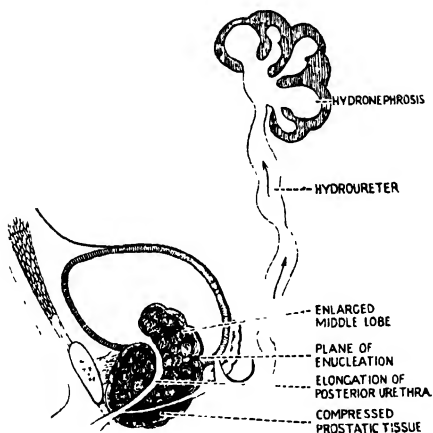


FIG. 56.—ILLUSTRATING SIMPLE ENLARGEMENT OF PROSTATE AND ITS CONSEQUENCES.

Hydronephrosis with hydro-ureter.

when localized to the mid-line, constituting the so-called 'middle lobe.'

2. *The Urethra*.—The posterior urethra is elongated, especially that part above the verumontanum; it is compressed laterally in symmetrical, distorted by asymmetrical enlargement. The internal meatus may be funnel-shaped, crescentic or irregular in outline.

3. *Effects on the Urinary Organs*.—These are the

result of obstruction followed by infection. The base of the bladder is raised, and behind the enlarged gland a *retro-prostatic pouch* forms, in which calculi may develop. The bladder becomes hypertrophied and trabeculated, with sacculi or even definite diverticula between the trabeculæ. When sepsis supervenes on the use of catheters, or independently, cystitis results, calculi form, and pyelonephritis follows from ascending infection.

Signs and Symptoms.—Usually these are of gradual onset with, at first, signs of irritability of the bladder, followed by evidence of obstruction, and finally chronic uræmia from renal failure. Septic complications are common in the late stages, though they may follow instrumentation in the earlier phases. All symptoms may be in abeyance and the diagnosis not be made until acute retention supervenes.

1. *Frequency of Micturition.*—This symptom is early but progressive, and both diurnal and nocturnal. Delay in starting the act is a common feature and, when cystitis supervenes, urgency of micturition is sometimes associated with slight incontinence. The stream is feeble, with gradual rise in power and a dribbling termination. There may be interruption in the act of emptying the bladder, the pauses lasting sometimes some minutes. Cold, alcohol, or failure to attempt to pass water regularly all tend to increase the difficulty and to promote absolute retention.

2. In most cases there is some degree of retention, the *residual urine* being from 3 ounces and upwards, to 10 ounces or more. Later the bladder may be constantly in a state of distension, with frequency and often slight incontinence.

3. When *acute retention* supervenes there is great pain and distress, which may only be relieved by the passage of a catheter, though sometimes the power of micturition gradually returns spontaneously.

4. *Hæmaturia* is sometimes a marked feature, in others it is absent throughout.

5. *Pain*, apart from acute retention or the super-vention of cystitis, is not usually prominent.

6. *Sexual irritation* may be distressing and lead the patient to excesses or to the commission of offences against decency, such as exhibitionism, assaults on children, etc.

7. *Uræmic phenomena* are met with in advanced cases—thirst, headache, a dry tongue, wasting, nausea and secondary anæmia.

8. By *rectal examination* the enlarged gland and its particular features can be palpated, or it may be little if at all increased in size, the enlargement being purely intravesical.

9. By *cystoscopy* the residual urine is estimated and the presence of a collar-like projection, a middle lobe, or an asymmetrical enlargement is visible; the relationship between the projecting mass and the position of the ureteric orifices gives a guide to the degree of enlargement. Fasciculation, sacculation, diverticulum formation and calculi may be revealed. Estimation of the excretory function of the kidneys by the indigo-carmin or other colorimetric tests can be completed with the cystoscope *in situ*.

Complications.—These often arise—*e.g.*, retention of urine, ascending infection of the urinary tract, epididymitis, stone, stricture and renal failure.

Ascending Infection.—This often follows the use of the catheter to relieve retention. It may be acute, with rigors or high temperature, pain and frequency of micturition, or may develop insidiously and resemble chronic uræmia, with drowsiness, delirium and suppression of urine.

Epididymitis is frequently due to habitual catheterization.

Calculi form in 7 per cent. of the cases, are often multiple, and consist of oxalates, uric acid or, when there is much urinary decomposition, of phosphates. The retro-prostatic pouch is the usual situation of these calculi and their presence is often unsuspected.

Course and Prognosis.—The condition is progressive, though its course may be prolonged. Eventually, renal deficiency combined with septic infection determines a fatal issue. Malignant disease

may develop in the enlarged prostate in a small percentage.

Diagnosis.—The age of onset and the particular type of defective micturition with attacks of retention strongly suggest prostatic enlargement, and this is confirmed by rectal examination and by cystoscopy. In urethral stricture there is difficulty in emptying the bladder without frequency, and the site of obstruction can be proved to be in the urethra by means of bougies or the urethroscope. Malignant disease of the prostate is associated with obstruction out of proportion to the bladder irritation, and the characteristic defect in the act of micturition is not present. Hæmorrhage is less frequent in malignant than in simple prostatic enlargement, but the inguinal glands are often enlarged and the prostate itself is much harder, more irregular and sometimes fixed.

Treatment—General Measures.—In the lesser degrees of enlargement, much can be done to avoid attacks of retention, and therefore instrumentation, with its dangerous sequelæ, by avoiding alcohol, cold, late hours, stimulating foods, bicycling, horse-riding, etc., combining this with free use of mineral waters such as Contrexeville and careful attention to the bowels.

Catheterization is desirable only if acute retention supervenes, and should be employed with the greatest attention to asepsis, the urine should be withdrawn gradually, particularly if there is evidence of chronic renal deficiency. Coudé or bicoudé silk-web gum-elastic instruments of fairly large size should be selected, and prostatic silver catheters employed only if these have failed. 'Catheter life'—*i.e.*, the regular passage of a catheter as a substitute for operation—is to be avoided whenever possible, as it inevitably results, sooner or later, in cystitis, ascending pyelonephritis and a fatal uræmia; it is true that in certain favourable exceptions patients have survived this régime for years, but as a rule such patients are wealthy and leisured and have had the benefit of regular skilled surgical supervision.

Operative Treatment.—This resolves itself into

(1) removal of the enlarged gland by a suprapubic or perineal route, or (2) transurethral extirpation of such portions of the gland as are causing obstruction.

1. *Prostatectomy*.—This is indicated whenever the enlargement is of the soft and bulky variety, particularly when the middle lobe is the main obstructing factor. It is a serious operation in the elderly patients who most often need it, but the risks can be reduced materially by careful preparation of the patient. The most vital necessity is preliminary drainage of the bladder by a suprapubic or transurethral method, the former being by far preferable. By this two-stage method the renal function is stimulated, and the danger of post-operative uræmia greatly lessened. Calculi can be removed at the same time and segments of the vasa deferentia excised in order to avoid epididymo-orchitis following the prostatectomy. The more robust and younger patients who retain a high renal efficiency can, however, dispense with a two-stage operation.

Suprapubic Prostatectomy.—This has the advantage that it is seldom, if ever, followed by permanent incontinence, and in favourable cases the danger of post-operative hæmorrhage can be reduced by free exposure and hæmostatic suture of the prostatic bed, after enucleation of the tumour; it is also possible to obliterate the prostatic cavity and restore the posterior urethra by suitable sutures and the use of an indwelling catheter. Primary suture of the bladder can judiciously be employed in favourable cases (Harris's method). In many it is wiser to employ a hæmostatic bag (Pilcher's or Ogier Ward's) and to drain the bladder freely. Pulmonary complications are greatly to be feared, and spinal anæsthesia with gas and oxygen is the best routine. Skilled post-operative nursing and attention are of vital importance. Urinary control after the operation depends in most cases on the activity of the compressor urethræ, in only a minority on restoration of the tone of the vesical sphincter.

Perineal Prostatectomy.—This is carried out through a transverse prerectal incision, utilizing a special staff, which can be made to act as a tractor on the

prostate during the enucleation, while helping to protect the urethra from damage. The mortality of this operation is slightly less than that of suprapubic prostatectomy, but recurrence of the tumour, incontinence, fistula and stricture are more to be feared. The perineal operation is, therefore, generally reserved for small hard prostates, which are equally amenable to the transurethral method of resection by diathermy.

The post-operative complications of prostatectomy are shock, hæmorrhage, uræmia, septicæmia, bronchitis, pneumonia, cerebral hæmorrhage or thrombosis, and pulmonary embolism. Of these, hæmorrhage may be prevented by the method of direct hæmostasis, or by employing one of the bags referred to above, but if it occurs in spite of these, the prostatic cavity must be packed with strips of gauze, which are left in for forty-eight hours. If secondary hæmorrhage arises later, firm packing as before, with recumbency and morphine, are the indications. Uræmia demands energetic diuresis, together with fluid by the mouth and rectum, and hypertonic saline or isotonic glucose (4·7 per cent.) intravenously by the drip method.

2. *Transurethral Resection*.—In a certain proportion of cases, including those unfavourable for prostatectomy—viz., when the prostate is hard and fibrous and obstruction localized to the region of the internal meatus—relief is afforded by excising portions of the prostatic tissue under visual control with a wire loop by diathermy. As with prostatectomy, it may sometimes be wise to drain the bladder as a preliminary measure. There is very little shock and seldom any appreciable hæmorrhage by this method, but very careful selection of cases is requisite, and recurrence of symptoms is more likely than after suprapubic prostatectomy. The patient need seldom stay more than a few days in hospital with this method of treatment, in contrast to the usual three to six weeks after prostatectomy.

Atrophy of the Prostate.—Though rare, this is of some clinical importance. The gland is greatly reduced in size and may be hardly palpable. It is firm

and greyish-white on section, with mere scattered traces of gland tissue, and the fibrosis often spreads into the posterior urethra and neck of the bladder. To this and allied conditions which cause obstruction without gross prostatic enlargement the general term 'median prostatic bar' is applicable.

Signs and Symptoms.—Frequency, nocturnal and diurnal, with great urgency, nocturnal enuresis and sometimes complete incontinence are features. The stream is generally weak and dribbling, but complete retention is rare. The posterior urethra is shortened, but there may be obstruction to the cystoscope at the internal meatus.

Diagnosis is made by rectal palpation aided by the passage of a sound, which can be felt with great ease in the posterior urethra, whereas in prostatitis and in malignant disease the sound is obscured by the tough prostatic tissue.

Treatment.—Transurethral diathermy-excision of the fibrous tissue is the ideal method.

Malignant Disease of the Prostate—1. **Sarcoma.**—Though rare, this occurs (unlike carcinoma) at all ages. Besides the common histological types, rhabdomyo-sarcoma is recognized.

Signs and Symptoms.—Urinary obstruction, hæmaturia and pyuria, with a bulky enlargement of the gland and early metastases in the lungs, etc., are the main features.

2. **Carcinoma.**—This, which constitutes about 20 per cent. of all prostatic enlargements, may originate in a simple prostatic enlargement, although the evidence for such a statement is not conclusive. The prostate may be relatively small, but usually it is bulky, hard and nodular, though soft medullary forms are described. Clinically the following types are of importance:

(a) The carcinoma discovered after histological examination of a prostate enucleated as a simple enlargement.

(b) The rapidly infiltrating type, which spreads into the bladder, rectum, glands and pelvic wall (diffuse prostatico-pelvic carcinoma of Guyon).

(c) An obscure primary growth in the prostate, which may be of normal size, associated with widespread secondary deposits in the bones of the skeleton. Sometimes these secondary deposits are actively osteoplastic, in others there is bone destruction and spontaneous fracture. The growth is usually an undifferentiated spheroidal carcinoma, but when it has a tubular structure is relatively benign.

Signs and Symptoms.—(a) Difficulty in micturition associated with a delayed small feeble stream and after-dribbling. Occasionally there is incontinence without distension of the bladder, the sphincter being widely infiltrated and its action destroyed by the growth.

(b) Pain is sometimes an early symptom and may be independent of micturition; it results from involvement of pelvic nerves, is dull and neuralgic, being referred to the penis, urethra, rectum, anus, perineum and hypogastrium, etc.

(c) Hæmaturia is rare and seldom copious.

(d) Pyuria follows ulceration into the bladder.

(e) Constipation and, later, intestinal obstruction may follow.

Rectal examination reveals a stony-hard, fixed, nodular, irregular enlargement of the prostate, and the rectal mucosa may be fixed to the mass. There is a tendency to involvement of the vesiculæ seminales and base of bladder, and sometimes the growth surrounds the rectal wall. The prostatic urethra is often much distorted, but there is seldom gross intra-vesical enlargement; the cystoscope may be difficult to insert and bleeding is usually set up easily, obscuring the field of vision. Clinically, the diagnosis has to be made from urethral stricture rather than from simple enlargement, but in stricture the symptoms arise earlier and there is less pain and no emaciation. Prostatic calculi are distinguished by the skiagraphic appearances, the passage of a sound or cystoscope usually revealing crepitus or a definite click.

Treatment.—1. *Palliative.*—Usually this is the only course feasible. Sedative drugs are to be preferred to local treatment for as long as possible, but a permanent suprapubic drain is often necessary in the

end. Radium therapy has so far been disappointing, but high-voltage X-ray therapy is more promising.

2. *Radical*.—Suprapubic prostatectomy is not suitable for diagnosable malignant tumours, as it is impossible to extirpate the whole of the malignant tissue. The portion remaining spreads rapidly after the operation and interferes with sphincter action. In selected cases transplantation of the ureters into the pelvic colon, followed at a second stage by extirpation of the bladder, prostate and vesiculæ seminales, offers the only hope of radical cure.

THE VESICULÆ SEMINALES

Spermatocystitis, Vesiculitis.—The seminal vesicles are susceptible to acute and chronic inflammations which are invariably secondary to urethritis.

Causes.—Usually the gonococcus, but *Bact. coli*, staphylococci and streptococci are occasionally responsible.

Pathology.—There is thickening and swelling of the mucous lining of the vesicle and the secretion is retained, being mixed with pus and spermatozoa. In the chronic forms, fibrous thickening of the wall of the vesicle with perivesiculitis is the rule, and finally the lumen becomes distended.

Acute Spermatocystitis.—*Signs and Symptoms* are those of the associated acute posterior urethritis—viz., frequency of micturition, scalding pain, terminal hæmaturia and slight pyrexia. Painful erection and frequent emissions are characteristic, and the seminal fluid is stained with altered blood. Widespread aching in the perineum and sacrum may be associated with intense pain on defæcation. The doughy, sausage-shaped, enlarged vesicles can be felt per rectum. The condition usually subsides gradually, but prostatitis and epididymitis often complicate convalescence.

Treatment.—All active treatment for gonorrhœa should cease and be replaced by diuretic waters and sandalwood oil by mouth, combined with morphine and atropine injections and hot rectal douches.

Chronic Spermatocystitis.—Usually this accompanies chronic prostatitis.

Signs and Symptoms.—Frequent erections and emissions, the semen being passed mixed with pus and altered blood. The patient is depressed and neurasthenic, and complains of widespread aching pain in the perineum, urethra, all the pelvic joints, and often more remotely. It is a common cause of chronic backache in the male.

Diagnosis.—The enlarged vesicle can be felt per rectum as a tender, tough, sausage-shaped mass. In tuberculosis, on the other hand, the swelling is hard and nodular. Chronic urethritis often accompanies the vesicular disease, but the latter can be differentiated by washing out the urethra by Janet's method, followed by massage of the vesiculæ per rectum. The resultant fluid expressed per urethram will reveal both pus and blood.

Treatment.—Massage with the gloved finger per rectum is the only reliable method, followed by Janet's method of irrigation and potassium iodide internally. Vasotomy with irrigation of the vesicle is often valuable. If all else fails, the vesicle may be removed through a curved prerectal incision.

Tuberculous Vesiculitis.—This is rarely if ever primary, though it is not uncommonly the first lesion detected in the course of genito-urinary tuberculosis. Usually the prostate and epididymis are also obviously involved.

Signs and Symptoms.—These are seldom conspicuous, but frequent erection with painful bloody emissions often go in company with pain at the root of the penis. Per rectum the nodular vesicle is palpable, the prostate may be found similarly affected and the cystoscope reveal vesical lesions.

The course is very chronic, but eventually spread to the urinary tract is to be feared.

Treatment.—General hygienic measures, if necessary combined with sanatorium treatment and injections of tuberculin T.R. Excision of the affected vesicle, if it appears to be an isolated lesion, is sometimes justifiable.

Hæmatospermia (blood-stained semen) is usually the result of congestion of the sexual organs. It has little significance except in connexion with acute or tuberculous vesiculitis, but may occur in ureteric calculi lying near the seminal vesicles.

CHAPTER XLIII

AFFECTIONS OF THE URETHRA AND PENIS

THE URETHRA

Examination of the Urethra involves the necessity not only for careful palpation, but skill in both anterior and posterior urethroscopy. For the latter, local instillation of 5 per cent. novocaine or 0.25 per cent. percaine by means of a Guyon's syringe may be required in sensitive patients, in whom otherwise there is risk of *urethral shock* associated with feebleness of the heart, dilated pupils, unconsciousness and usually a fatal termination. Urethrography is of great value in the exact diagnosis of obscure cases.

Urinary, Urethral or Catheter Fever.—The sharp pyrexial attack which occasionally follows the passage of a catheter, bougie, or cystoscope is sometimes regarded as of reflex nervous origin, though in all probability it is always due to sepsis. There is a special proclivity to urethral fever in obstructive lesions, particularly of the bulbous and posterior urethra. The feverish attack may be short and non-recurrent, but it sometimes ushers in an attack of pyelitis or pyelonephritis, and if the kidneys are already seriously involved, suppression of urine and uræmia may follow.

Treatment is essentially preventive—*i.e.*, gentleness in the passage of all instruments, which must be scrupulously sterilized. When the condition asserts itself, urinary antiseptics and diuretics should be administered, followed when necessary by trans-urethral or suprapubic bladder drainage.

Congenital Anomalies of the Urethra—*Complete Atresia.*—The urethra may fail to develop and the

penis is rudimentary. There are always other gross malformations incompatible with survival.

Partial Atresia involves the anterior urethra more often than the posterior, and the bladder, ureters and kidneys are distended, though some urine may escape via abnormal fistulæ into the rectum or vagina. Only in the minor degrees—*e.g.*, affecting the glans penis—is it possible to relieve the obstruction promptly enough to save life.

Double Urethra is very rare and may accompany double penis, double scrotum, double bladder, etc. Sometimes the second urethra opens in the perineum, but more often it exists as a canal traversing the upper or lower surface of the penis. It rarely forms a complete channel into the bladder, but is usually 'blind,' and in this event can be treated by complete excision.

Congenital Stricture.—May involve the external meatus, the membranous or prostatic urethra. Meatal narrowing can be cured by a plastic operation, but more deeply-seated defects need regular dilatation with bougies, preceded in some cases by internal or external urethrotomy.

Epispadias.—The urethra opens on the upper surface of the deeply cleft penis. The urethral orifice may open (1) behind the glans; (2) in the body of the penis; (3) as a wide gutter on the dorsum, being almost always associated with ectopia vesicæ. The last is the common type and the penis is small with atrophic corpora cavernosa, whereas in the rarer types these are well developed, but short.

Treatment.—For the type associated with ectopia the treatment is as for that condition (see p. 564). For the minor degrees, plastic operations are sometimes helpful.

Hypospadias.—A condition of arrested development of the penis (often associated with gonadal defects), in which the urethra opens on the under surface of the penis, which itself shares in the abnormality. There are three types: (1) *Hypospadias glandis*; (2) *hypospadias penis*; (3) *hypospadias perinealis*.

1. *Hypospadias Glandis*.—This common type is due

to failure of the epithelial plug, forming the terminal part of the urethra in the glans penis, to canalize. The urethra opens just behind the glans and the meatus may be pin-point. The prepuce is redundant, the glans slightly bent on the body of the penis, but erection and coitus are possible.

2. *Hypospadias Penis*.—The urethra opens in the body of the penis, usually at its junction with the scrotum. On the under surface of the penis lie two band-like structures representing the corpus spongiosum; they draw the organ down and prevent normal erection. The whole penis is ill-developed and the urinary stream cannot be projected properly: normal coitus is impossible.

3. *Hypospadias Perinealis*.—Is rare and accompanied by cleft scrotum and imperfect descent of the testes. The urethral opening is placed deeply in the perineum and accurate differentiation of sex is difficult, the penis being very small and the patient obliged to micturate in the squatting position.

Treatment.—For the first degree a simple plastic operation suffices, if indeed any operation is really required. The meatus should always be examined carefully, as it is so often narrowed. In the penile type, Bucknall's operation, by which the skin of the scrotum is utilized to convert the existing groove into a complete channel, is among the best, but it is seldom possible to restore both the appearance and the function of the penis.

Injuries of the Urethra.—(a) *Gunshot wounds* of the urethra occur in military practice and may be associated with injuries to the rectum and fracture of the pelvis. If there is a large wound of exit, extravasation of urine is unlikely, but if valvular there may be extensive infiltration of the cellular tissues. Exploration of the wound, excision of badly damaged tissue, with suture of the urethra over an indwelling catheter, and free drainage, are the essential points.

(b) *Rupture*.—This may be *partial* or *complete*; in the latter wide separation of the ends of the urethra is to be feared. The site of laceration is governed by the direction of application of the rupturing blow, but

the bulbous and membranous parts are most often concerned.

Signs and Symptoms.—In penile rupture, hæmorrhage from the urethra, pain on micturition and sometimes retention are present, but extravasation is absent. If the bulb is torn, a tense swelling appears in the perineum and retention follows. When the membranous part is ruptured, hæmorrhage is slight, but there is retention and later a large perineal bruise; extravasation follows attempts at micturition in these cases. Passage of a catheter reveals the site of obstruction and serves to differentiate extraperitoneal rupture of the bladder, in which in addition the latter is not distended. Urethral injuries are very frequently followed by stricture.

Treatment.—If a catheter can be passed into the bladder, it should be tied in for a few days and, at a later date, dilatation kept up regularly. If a catheter is impassable, an incision is made in the perineum, blood clots washed away, and the rupture sutured with fine catgut over a catheter, which is then removed and a suprapubic drainage tube is placed in the bladder. In intrapelvic rupture of the urethra the danger of stricture is so great that the apposition of the ruptured ends must be secured by a combination of suprapubic and intraurethral instrumentation followed by an indwelling catheter for several days.

Urethral Calculus.—A stone may form in the urethra (primary) or lodge there (secondary). Primary calculus is the result of deposits in an inflamed area, particularly behind a stricture or in a sacculus; it may be of the mixed phosphate or carbonate variety. Secondary calculi have the normal uric acid or oxalate nucleus. The urethra distends as the calculus enlarges, and the latter may eventually project into the bladder.

Signs and Symptoms.—If impaction of a calculus from above occurs, there is a history of renal colic. As the calculus enters the urethra, it gives rise to sudden pain, stoppage of the stream with strangury, and retention of urine. A sound or urethroscope reveals the site of the stone. In primary calculi

urethral discharge, pyuria and frequency are present, but pain is not so severe and the stream is not completely stopped, though it is often feeble. Stricture and urinary fistulæ often coexist.

Treatment.—A calculus lodged in the prostatic urethra can be replaced in the bladder by passing a large bougie, after which it should be treated by litholapaxy. If the stone is in the anterior urethra, it may sometimes be removed with urethral forceps, but it is often wiser to perform external urethrotomy to enable the stricture, which often accompanies it, to be divided and the stone to be extracted.

Foreign Bodies, sometimes of the most bizarre types, may find their way into the urethra. They are often inserted wilfully for erotic purposes, but may be the result of fracture of catheters, etc. Urethral discharge, burning pain and hæmorrhage are the usual complaints, and rétention of urine may follow. Ulceration results if the foreign body remains *in situ* for any great length of time, and periurethral abscesses and sinuses develop. If foreign bodies cannot be removed through a urethroscope or by urethral forceps, an external urethrotomy is necessary.

Stricture.—The urethra may be narrowed congenitally (see *ante*), or as a result of (1) inflammation, (2) trauma. Females are seldom affected. The age of onset is twenty to forty.

Inflammatory stricture follows urethritis and 90 per cent. of cases are due to gonorrhœa, aggravated by the use of strong antiseptics, alcohol, the presence of phimosis, or a narrowed meatus. Rarely a urethral chancre may be the cause.

Traumatic stricture is due to the mass of scar tissue which develops after rupture of the urethra. Its length and density vary, but it is never multiple.

Inflammatory strictures are frequently multiple and in the bulbous portion, rarely if ever in the posterior urethra. The stenosed part is usually short and *annular*, with fibrous tissue surrounding the mucous layer, but in others it may assume a *bridled*, *tortuous*, *resilient*, *cartilaginous* or *irritable* nature, these terms being self-explanatory. An *impassable* stricture is

one through which it is impossible to pass any instrument; in an *impermeable* one the urine cannot find an exit. The fibrous tissue may be localized to one part of the urethral circumference, resulting in an eccentric position of the lumen of the strictured area. The urethra proximal to the stricture is dilated, ulceration and calculus formation may follow, and back-pressure effects on the bladder and upper urinary tract supervene in neglected cases, eventuating in fatal pyelonephritis.

Signs and Symptoms.—In narrow strictures micturition gradually increases in difficulty, with a twisted, forked, sprayed, fine jet, but in wider strictures a chronic gleet may alone be noticed. Pain and frequency of micturition follow from the associated urethritis and cystitis, and later there may be lumbar aching. Ejaculation is often painful, and as the semen returns into the bladder, sterility is favoured.

Acute retention may develop following alcoholic excess or exposure to cold, the bladder being palpable above the pubes, and the frequent painful attempts at micturition are either ineffective or result in the passage of merely a few drops of urine. In some cases the retention assumes a chronic character and may be associated with overflow incontinence, with but little pain. When cystitis is prominent, diurnal and nocturnal frequency are assertive. On palpation the thickened area corresponding with the stricture may be detected, and its site determined by means of a gum-elastic bougie of moderate size, which cannot be passed beyond the narrowed area. The urethroscope gives more precise information as to the character of the stricture. An acorn-headed bougie will enable the length of a stricture to be established, but this applies only to those large enough to allow such a bougie to pass.

The spasmodic stricture due to contraction of the compressor urethræ in posterior urethritis is situated more deeply than an inflammatory stricture and yields to the gentle continued pressure of the exploratory bougie.

Complications.—I. *Retention of urine.*

2. *Sepsis*, local and remote—viz., urethritis, peri-urethral abscess, prostatitis, epididymitis, cystitis, pyelonephritis and pyonephrosis.

3. *Extravasation of urine*.

4. *Fistula*.

5. *Urethral stone*.

6. *Carcinoma of urethra*.

Treatment: I. *Dilatation*.—Flexible silk-web gum-elastic bougies are the safest, especially for the initial treatment, but rigid metal instruments are often preferable for subsequent regular dilatation. It is a good rule to begin with moderate-sized bougies, then smaller sizes until an instrument can be found to pass through the narrow canal. Filiform or whale-bone bougies are dangerous unless used with the greatest discrimination; if several filiform bougies are passed down to the site of stricture, manipulation of each individual bougie may enable one to be passed through. It can be left *in situ* and the others removed. A local, general or spinal anæsthetic may permit the passage of a bougie in an otherwise impassable case.

Dilatation may be (a) *Intermittent*—the method of choice. The largest bougie which can be passed easily is introduced, and subsequently, at intervals of a few days, larger sizes are inserted until eventually dilatation to 22 F is reached. The interval between the sessions can now be increased up to some months, and finally a yearly dilatation is often sufficient. (b) *Continuous*: When a filiform bougie only can be passed, this is fixed in position and the patient kept in bed. Urine escapes alongside the bougie, the stricture softens, and within a day or so a larger instrument can be used, followed later by intermittent dilatation as described above. (c) *Rapid*: The full range of bougies is passed at one sitting. This, though sometimes successful, is liable to be followed by the formation of a resilient stricture.

Complications.—(1) False passage, indicated by bleeding and by the peculiar grating feeling imparted to the hand which holds the bougie; (2) infection and catheter fever (see p. 593); (3) syncope.

II. Operation is indicated:

1. If dilatation fails, as in cartilaginous, resilient and irritable strictures, or if hæmorrhage, epididymitis, retention or extravasation of urine follow.

2. If dilatation is impossible, as in impassable strictures, or those associated with stone, fistula, enlarged prostate and renal complications.

Internal Urethrotomy.—The stricture is divided by a guarded knife (internal urethrotome). The filiform guide attached to the instrument must be capable of being passed through the stricture, and a triangular knife is then guided along the urethra and cuts through the stricture from before backwards. A catheter must be tied into the urethra for a day or two and gradual dilatation then instituted.

External Urethrotomy.—(a) With a guide (Syme's operation). It must be possible to dilate the stricture up to No. 4 English gauge. The instrument is passed in the lithotomy position, its shoulder resting against the stricture. The knife is carried backwards along the ventral groove and divides the stricture from before backwards. A de Pezzer's catheter is then introduced through the urethra and manipulated into the bladder.

(b) Without a guide (Wheelhouse's operation). The staff is passed down to the stricture and the urethra opened by a longitudinal incision 1 inch from the end of the staff. The edges of the incision are carefully retracted and the lumen of the stricture sought for with probes and seekers until eventually it is possible to divide the fibrous tissue, to open the urethra proximal to the stricture, and to insert a de Pezzer's self-retaining catheter from meatus to bladder. It is allowed to remain a few days, after which gradual dilatation is maintained during and following the healing of the urethral incision.

Excision.—A single stricture may be excised through a longitudinal incision. If less than 1½ inches of the urethra is removed, an end-to-end resuture of the canal over a catheter is often successful; if more than this is excised, regeneration of the mucous membrane alongside an indwelling catheter may eventuate in a satisfactory result.

Urethritis.—This may be acute or chronic. The vast majority of cases follow gonorrhœa (see p. 28), but there are also varieties due to:—

1. *Bact. coli*.—This is found in both sexes, the discharge being paler and less viscid than in gonorrhœa. Should epididymo-orchitis supervene, suppuration is likely to follow and sloughing of the testis may ensue. All forms of local treatment are undesirable, but reliance must be placed on a ketogenic diet, or the exhibition of alkalies and sulphonamide.

2. *B. proteus*.—In this the pus is offensive and dark-coloured. Treatment is as for *Bact. coli* urethritis.

3. *Staphylococci*.—In this form a yellowish, inoffensive, purulent discharge appears, usually following on instrumentation or the use of an indwelling catheter. Removal of the cause rapidly effects a cure.

Periurethral (Urinary) Abscess.—This may be found in the acute stage of urethritis, but is more commonly met with behind a stricture. A tender swelling appears, which softens and bursts into the urethra or through the skin, or both, and in the latter event a fistula forms. If the bulbous urethra is affected, a large swelling may appear insidiously; it is limited behind by the fascia of Colles, but passes forward under the scrotum.

Treatment.—If the penile urethra is involved, these abscesses can be opened with a small knife introduced through an urethroscope. The perineal type needs a wide incision, free irrigation and drainage.

Extravasation of Urine (*Diffuse Phlegmonous Periurethritis*).—A virulent spreading cellulitis associated with sloughing of the urethra, and usually though not invariably in connexion with a stricture. The onset is sudden, the symptoms severe, with a rigor and high fever, followed by toxæmia, pallor, clammy skin, dry brown tongue and delirium. There may be complete retention of urine, or a little may be passed with pain and straining. A brawny dusky red swelling appears in the perineum, limited behind by Colles' fascia, but spreading forwards to the scrotum, penis and abdominal wall. Crepitation of the tissues due to gas-forming anaerobes may be detected

Treatment.—Multiple free incisions throughout the affected area are the prime necessity. Irrigation of the subcutaneous tissue with weak antiseptics—*e.g.*, *ousol*—is helpful, but not essential. Warm moist applications to the wounds, and free stimulation of the patient, with ample fluid by mouth, rectum or intravenously, often lead to recovery. Treatment of the urethral lesion must be deferred until the patient has passed the critical period.

Chronic Indurative Periurethritis.—This is a complicated cartilaginous stricture of the bulbous urethra. Fibrous indurated masses form in perineum and scrotum, multiple fistulæ appear, calculi arise in the fistulous tracks, and malignant disease is not unknown as a sequel.

Treatment.—Internal or external urethrotomy is required as a preliminary to the complete extirpation of the indurated tissue with its fistulous tracks. Healing is by granulation.

Neoplasms of the Urethra.—Simple papilloma and angioma occur. Squamous carcinoma at the common sites of stricture is amenable to surgical and radiological treatment.

THE PENIS

Phimosis, or inability to withdraw the prepuce from the glans penis, may be congenital or acquired.

1. **Congenital.**—The prepuce at birth is slightly adherent, but becomes freed within a few years; mere inability to retract the prepuce fully at birth is not therefore an abnormality, and calls for no treatment. This fact is often ignored.

Circumcision is called for (1) if the prepuce is very long; (2) if the preputial orifice is so small as to constitute an obstruction to micturition; (3) if the prepuce is adherent to the whole surface of the glans penis; (4) if on retraction of the prepuce there is a tendency to paraphimosis (*q.v.*).

Complications.—(a) Pain and difficulty on micturition. Retention of urine, with back-pressure effects on the urinary tract.

(b) Retention of secretion, with formation of calculi under the prepuce.

(c) Inflammatory lesions (balano-posthitis).

(d) Paraphimosis.

(e) Malignant disease.

Many other complications, such as incontinence of urine or tendency to masturbation, are described, but their connexion with phimosis is doubtful.

Treatment.—Pinhole meatus is often associated with phimosis and must be looked for. Mild degrees can be cured by breaking down adhesions with a probe, followed by daily retraction and careful cleansing. Circumcision should be done in such a way as to leave sufficient prepuce to cover at least a half of the glans penis; the drastic removal of the whole foreskin, which subsequently leaves the entire glans exposed, is to be condemned.

2. *Acquired.*—(a) Follows inflammatory swelling in association with soft or hard sores or acute gonorrhœal balano-posthitis; it is temporary and passes off with the subsidence of the inflammation, but may need a simple dorsal incision of the prepuce. (b) It may also be due to adhesions between the glans penis and prepuce following ulcerative lesions.

Paraphimosis.—Inability to replace the prepuce after its withdrawal. An *acute* form occurs (a) in boys and young men after retraction of a tight prepuce; (b) after coitus; or (c) in acute gonorrhœa or chancre. The glans penis is congested, the tight prepuce acting as a tourniquet; behind the exposed corona are two collar-like rolls of tissue, the distal one red and composed of the inner mucous layer of the prepuce, the proximal paler and consisting of skin; behind them a deep furrow indicates the site of the preputial orifice. The penis is engorged and often twisted.

Treatment.—Reduction may be effected by gradual compression of the glans penis so as to diminish its size and permit reposition of the prepuce. Iced applications are helpful adjuncts. Division of the constrictive band may be necessary if the manipulative method fails. Circumcision must follow.

Chronic Paraphimosis may follow the acute form if the condition is unrelieved, and needs a plastic operation for its cure.

Herpes of the Penis.—Both the catarrhal type and herpes zoster occur, the former more commonly. The catarrhal form attacks the prepuce and glans penis. The cause is a virus.

Signs and Symptoms.—Itching on the prepuce or glans penis is followed by erythema, on which a crop of small vesicles appears; the latter burst and dry up in about a week. Recurrence is not unusual. No active treatment is necessary.

Priapism.—Persistent painful erection without sexual desire. The corpora cavernosa are affected, the corpus spongiosum is intact. Excessive coitus, injury, alcoholism, leukæmia and balano-posthitis are possible causes. The semi-turgid state of the penis which sometimes follows injury to the cervico-dorsal region of the spinal cord is not a true priapism.

Signs and Symptoms.—The penis is tender and painful, and there may be difficulty in micturition. The condition has been known to persist for weeks.

Treatment.—Large doses of sedatives such as potassium bromide should first be tried; if this treatment fails, aspiration of the contents of the corpora cavernosa under local anæsthesia should be essayed, resorting to incision of the corpora only if this fails.

Neoplasms of the Penis—1. INNOCENT: **Papilloma.**—Both hard and soft varieties occur; the former is localized and may develop into a *horn* several inches long, or become the site of epithelioma. The soft variety usually complicates venereal disease, but may be independent of infection. They occur on the sulcus or on the glans, are pedunculated or sessile, bleed readily and have a foul secretion; the inguinal glands are enlarged.

Treatment.—Removal with scissors and cauterization of the base.

2. MALIGNANT: (1) **Carcinoma.**—Two types occur: (a) squamous—common; (b) adeno-carcinoma, be-

ginning in the glands of Tyson—rare, but very malignant.

Causes.—It is elderly men suffering from phimosis and usually uncleanly in their habits who are attacked. A chronic superficial inflammation of the glans and prepuce, resembling leucoplakia linguæ, may also precede carcinoma; the prepuce becomes difficult of withdrawal, especially as there is a tendency to hæmorrhage if this is attempted; leucoplakic patches are often visible.

Signs and Symptoms.—The first indication is the formation of a warty growth on the glans penis or in the sulcus. Induration precedes ulceration and the growth remains limited to the superficial tissue, but eventually the body of the penis is invaded and extensive ulceration and destruction follow with involvement of the inguinal glands. Urinary fistulæ may appear. Pain is often so trivial that the disease is already advanced when the patient is first seen.

Diagnosis.—In all elderly men with a blood-stained or purulent discharge from under the prepuce, an incision should be made to permit of inspection of the whole glans.

Treatment.—The growth must be removed with a wide margin of healthy tissue, together with the inguinal glands on both sides. If the disease is early, the penis can be amputated and the inguinal glands excised *en bloc*; should the whole penis be involved, a more extensive operation, involving extirpation of the entire organ with detachment of the crura from the pubic bone, is necessary, the urethra being brought out in the perineum. An alternative method is to treat the primary growth with a radium applicator, combined with teletherapy by means of the radium bomb for the inguinal lymphatics. Circumcision may be required to permit satisfactory use of the radium applicator, and in some instances suprapubic cystostomy is desirable, in order to anticipate the interference with micturition which sometimes follows radio-therapy.

(2) *Sarcoma.*—The only primary connective tissue tumour of importance is a spindle-celled sarcoma

arising from the corpora cavernosa. The penis enlarges and is painful, micturition is obstructed, and a blood-stained urethral discharge is usual. Early amputation, together with extirpation of the inguinal glands, affords the only hope of cure.

CHAPTER XLIV

AFFECTIONS OF THE SCROTUM, TESTIS AND SPERMATIC CORD

THE SCROTUM

Cellulitis.—Occurs particularly in association with extravasation of urine. Swelling is extreme, and gangrene of the skin, followed by exposure of the testes, is to be feared, if free incisions are not made early.

Sebaceous Cysts.—Are occasionally seen.

Neoplasms—(a) **Innocent: Papilloma.**—Not uncommon, especially among chimney-sweeps, tar pitch and benzene workers. Often years after ceasing to follow the dangerous occupation, a chronic eczematous patch appears in which a soft wart develops.

(b) **Malignant:**

(i). **Epithelioma.**—Almost invariably a development from the preceding simple growth. Ulceration appears in the papilloma, or the latter may spread both superficially and deeply. The inguinal glands become infiltrated, though often at a long interval. Remote metastases are rare. Treatment demands the removal of the growth with a wide area of skin, and the extirpation of the inguinal glands of both sides. Advanced cases may necessitate removal of the testicle. Radio-therapy is advisable after operation and in the inoperable stage.

(ii.) **Melanoma.**—This is rare in the scrotum, but has the usual tendencies of the disease—viz., to involve glands at an early stage and disseminate widely. Treatment must be by radical excision; irradiation is seldom effective.

Elephantiasis.—With rare exceptions (due to widespread removal or disease of inguinal lymphatics) this is due to the *Filaria bancrofti* complicated by recurrent erysipelatoid attacks. Amputation of the affected tissue affords great relief.

THE TESTIS

Congenital Anomalies.—Supernumerary testes are almost unknown; complete absence is very rare indeed, and usually associated with other gross developmental defects of the sex organs. The testis is often, however, rotated so as to lie with the epididymis in front.

Imperfect Descent and Ectopia Testis.—The testis is drawn down from the region of the kidney to the scrotum by the action of the fibro-muscular gubernaculum, which has offshoots in the region of the iliac fossa, perineum, symphysis pubis, etc. Arrest in the course of descent to the scrotum is called *imperfect descent of the testis*, displacement via the line of the gubernacular offshoots is *ectopia testis*. In both types a hernial sac nearly always accompanies the abnormal testis, and in the ectopic class the sac is frequently of the interstitial variety (see Fig. 44, p. 431). Only in the minor anomalies in the group is the testicle well developed; frequently it is small and atrophic, spermatozoa being absent except occasionally for a short time at puberty. Malignant disease is probably more liable to attack the abnormally placed testis, and torsion is relatively common owing to the presence of a well-developed mesorchium. Spontaneous descent after puberty is unusual.

Diagnosis.—The condition is frequently overlooked in infants. On the other hand, it is often erroneously suspected, owing to the ease and frequency with which the testicle is withdrawn into the inguinal canal in children.

Treatment.—(a) *Endocrine Therapy.*—Extracts of anterior pituitary lobe have been shown to favour both testicular descent and development, but this

therapy fails in the more extreme degrees of mal-descent.

(b) *Surgical*.—The scrotal position is apparently essential for full testicular function; therefore every effort should be made to achieve this position. Operation, which should be done just before puberty, involves the freest division of all cremasteric tissues and bands, preservation of spermatic vessels, separation of vas upwards behind peritoneum, and replacement in scrotum without tension. If tension persist, fixation to the thigh by Torek's operation is often successful even in bilateral cases.

Torsion of the Spermatic Cord.—Said to be commonest in the abnormally placed testis, it occasionally happens to one which appears otherwise to be normal. The site of twist is at the globus minor, and the limits of rotation observed range from a half to three complete turns. Two clinical forms occur:

1. *Acute*.—This follows violent exertion—*e.g.*, jumping, etc. Pain is sudden and severe, with vomiting and shock, and a tender tense swelling is found in the inguinal or scrotal region, giving no impulse on coughing. It is difficult to distinguish from strangulated hernia, unless the testis is absent from its usual situation.

Treatment.—If the degree of torsion is slight the testis may be viable, but as a rule orchidectomy is the proper course.

2. *Chronic or Recurrent*—The symptoms of torsion described above pass off rapidly, but recur. The treatment is to suture the testis so as to prevent recurrence.

Torsion of the appendages of the testis and of the epididymis also occur; they are amenable to operative measures which conserve the function of the testis.

Injuries—1. *Contusion*.—Hæmorrhage occurs into the tunica vaginalis (hæmatocele) or under the tunica albuginea, with a tendency to produce atrophy. The injury is associated with severe shock and often with intense swelling of the parts.

Treatment.—Rest, elevation of the scrotum on a

pillow and application of cold evaporating lotions suffice for lesser injuries. If the tunica vaginalis is distended, puncture or incision is advisable, followed by drainage.

2. *Penetrating Wounds*.—If clean and of moderate size, these heal well. If infected, hernia testis may follow.

Epididymo-orchitis occurs in acute and chronic forms, with intermediate degrees. It may arise: (a) By spread from the bladder, prostate, etc., via the vas deferens—*e.g.*, gonococcal epididymitis. (b) By spread from the blood stream—*e.g.*, typhoid, syphilis, etc. (c) In association with gout. (d) From trauma.

Varieties.—1. **Gonococcal**.—This is a sequel to the spread of the disease along the vas deferens, and the infection may be pure or mixed. Alcohol, exercise, sexual excitement and strong antiseptics provoke it. The usual time is from the second to the fourth week after urethral infection.

Signs and Symptoms.—The onset is sudden, with pain, swelling and tenderness. The globus minor is first affected, but the rest of the gland is later involved, and a slight effusion containing gonococci appears in the tunica vaginalis. Mild fever and malaise are associated with considerable swelling of the testicle, reddening of the scrotal skin and thickening of the cord. Gradual disappearance of the swelling is the rule, but it may take months to subside completely. The urethral discharge often ceases during the acute stage.

Treatment.—All local treatment for gonorrhœa should be withheld, chemotherapy instituted, and the patient kept in bed on a low diet.

2. **Pyogenic**.—This is usually the result of instrumentation, may follow operation on the prostate and urethra, or develop in the course of a *Bact. coli* infection of the urinary tract. The terminations are resolution, fibrosis, or suppuration. If pus forms, it may occupy any of the following sites: (a) tunica vaginalis; (b) body of testis; (c) epididymis.

Treatment.—(1) *Of the Urethritis*.—Urinary antiseptics and sedatives, together with copious fluids

and calcium gluconate by the mouth. Sulphonamide therapy is an alternative.

(2) *Local*.—The testis is supported by a suspensory bandage or, if the patient is confined to bed, on a

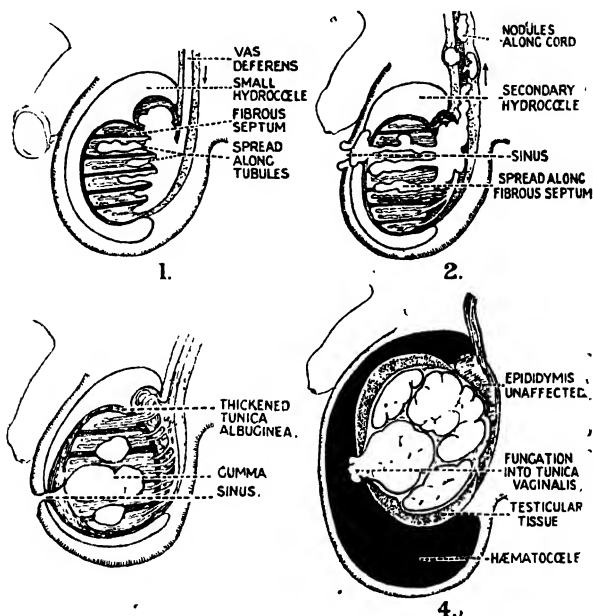


FIG. 57.—DISEASES OF THE TESTIS.

- 1, Gonococcal epididymo-orchitis; 2, tuberculous epididymo-orchitis; 3, syphilitic orchitis with gummata and sinus; 4, neoplasm of testis with secondary hæmatocœle.

pillow. Warm applications are usually more soothing than cold and help to favour resolution. If pus forms in the tunica vaginalis, this should be punctured; if in the testis or epididymis, a fine tenotome should be used to evacuate the abscess.

3. **Due to *Bact. Coli.***—This differs little from the preceding, except in the tendency to recurrence and the infrequency of suppuration. It is generally wrongly diagnosed as gonococcal in origin.

4. **Tuberculous.**—Almost invariably accompanies tuberculosis of other parts of the genito-urinary apparatus—*e.g.*, vesiculæ seminales and prostate. The epididymis is involved long before the testis, and the infection may spread via the lymphatics of the vas deferens from the prostate, etc., or be blood-borne. The disease affects in particular adults between twenty and thirty. There is an *acute* form closely resembling the gonococcal variety of acute epididymo-orchitis, but lacking the urethral discharge; and a *chronic* type, in which a nodule develops painlessly in the epididymis, usually in the globus minor.

Signs and Symptoms.—The epididymis is nodular; the nodules soften later and abscesses develop. The skin may become adherent over the globus minor and the abscess burst, leaving a characteristic sinus. There may be small firm masses along the cord (beading). The body of the testis is only slightly enlarged at first, but microscopically miliary tubercles can often be found in the mediastinum testis. A small hydrocoele may co-exist, and the whole testicle is less mobile than normal. Evidence of tuberculosis elsewhere in the genito-urinary tract is almost invariably discoverable. Both sides are often involved sooner or later. In the acute variety suppuration is the rule, whereas the chronic form may end in fibrosis, or pus formation is long delayed.

Treatment.—In *acute* cases, unless there are advanced lesions elsewhere in the genito-urinary tract, orchidectomy is advisable. In *chronic* cases sanatorium treatment is always to be tried if possible, combined with the use of tuberculin T.R. If this is not practicable or suppuration nevertheless supervenes, orchidectomy, together with removal of the vas deferens, is to be preferred to such half-measures as epididymectomy or curettage. Ultra-violet light therapy is often beneficial.

5. **Syphilitic.**—Disease of the testicle occurs in

both the acquired and inherited forms, but particularly in the late secondary and tertiary stages of the former. In the early secondary stage a painless epididymitis may involve the *globus major*. In the late secondary and tertiary stages the body of the testis is affected. It may take the form of: (1) A diffuse fibrosis, leading eventually to atrophy. (2) Gumma formation, followed by breaking down and the formation of a characteristic ulcer. Diffuse fibrotic and gummatous changes may coexist.

Signs and Symptoms.—In the gummatous variety the skin becomes adherent and then ulcerates, a wash-leather slough developing. When the slough separates, a *fungus testis* may form. In the fibrotic type the body of the testis is uniformly enlarged and painless, but nodules appear if gummata develop. Testicular sensation is lost early, but the feeling of weight so characteristic of malignant neoplasms is not present. The prostate and vesiculæ are unaffected, but a moderate degree of hydrocœle is the rule. If both testes are involved, impotence may eventuate.

Treatment.—Antisymphilitic remedies (see p. 35). If these fail to reduce the size of the testis, or if fungus testis has developed, orchidectomy is indicated.

Orchitis, with little evidence of involvement of the epididymis, occurs in: (1) gout; (2) typhoid fever and certain other epidemic diseases; (3) mumps. In the latter it develops between the sixth and eighth day of the parotitis. Young adults are those mainly attacked. The body of the testis is hard, tender and painful, and the skin over it red. Secondary hydrocœle is not unusual. Atrophy of the testis occasionally follows, especially in older patients.

Neoplasms—1. *Innocent.*—These are rare, but a few examples of *myoma* are on record, and *dermoids* have been described. Some of these are merely varieties of the teratoma mentioned below, but large encapsuled tumours have been found containing hair, teeth, etc., especially in connexion with the undescended testis.

2. **Malignant.**—Neither primary nor secondary

malignant testicular growths are very often seen. It seems probable that the imperfectly descended organ is more liable to malignant disease than one which is normally placed. The following varieties are described:

(1) *Sarcoma*.—Round, spindle and lympho-sarcoma are known, the first being the commonest.

(2) *Epithelioma*.—Extremely rare.

(3) *Carcinoma (Seminoma or Spermato-cystoma)*.—Columnar and spheroidal cell varieties are recognized. These tumours are radiosensitive.

(4) *Teratoma (Embryoma)*.—This is a diverse group, including fibro-cystic disease, chorion-epithelioma, chondro-carcinoma, etc. Their structure is extremely variable and complex; clinically they may vary widely in malignancy. The fibro-cystic structure can nearly always be found in some part or other of the tumour, the cysts being lined by columnar or flattened epithelium. Secondary growths may closely resemble the primary, but occasionally they differ widely from each other.

Signs and Symptoms.—The body of the testis is nearly invariably the site of origin. The gland enlarges uniformly and the tunica albuginea is not perforated for some time, but sooner or later the smooth tumour becomes nodular, of varying consistency, and testicular sensation disappears. The testicle, when supported, gives a sensation of great weight, and the epididymis can seldom be differentiated from the body of the organ. The tumour may be accompanied by a hydrocœle or hæmatocœle, the latter being usually the result of fungation of the growth into the tunica vaginalis. The cord is seldom affected, but the cremaster is sometimes hypertrophied. The skin is involved eventually, and the tumour may fungate through it. In time the lumbar glands are infiltrated, and it is not unusual for them to be enormously enlarged, while the primary growth is still quite small. Pressure on the vena cava may produce ascites and œdema of the lower limbs.

Diagnosis is difficult to make from hæmatocœle unless there is a definite history of injury. Large

quantities of *prolan A* may be present in the urine in certain malignant tumours of the testis (teratoma), but not in seminoma.

Treatment.—The radical operation involves the removal of the testicle, part of the scrotum, the cord and vas, and the spermatic vein up to the inferior vena cava on the right side, or the renal vein on the left, together with the lymphatic vessels and glands by the side of the aorta and vena cava from the common iliac to the renal arteries. This operation is only feasible in thin subjects, and is not advisable if there are palpable glands in the abdomen. In all cases deep X-ray therapy should supplement operation.

Cysts of the Epididymis (*Encysted Hydrocœle of the Epididymis*) (Fig. 58).—There are two main types: (a) small multiple cysts free from spermatozoa, occurring in men over forty, and (b) large single cysts containing spermatozoa, in men under forty. It is doubtful whether they are to be regarded as retention cysts or as due to foetal remnants of the organ of Giraldu. They occur in the globus major, extend upwards into the cord, and are frequently multiple and bilateral. The contents of these cysts are either (a) pale limpid fluid with a trace of albumen, or (b) milky white opalescent fluid containing albumen and spermatozoa.

Signs and Symptoms.—Pain is absent or trivial, and the swelling is noted by accident. It is of moderate size, translucent, and can be recognized as growing from the globus major.

Treatment.—If of small size, they may be ignored, but if bulky, may need to be tapped or excised.

Cysts of the Testis or Tunica Albuginea.—Very rare and probably traumatic in origin; they originate between the layers of the tunica albuginea.

Neuralgia Testis.—This is of three types:

1. Without any demonstrable lesion of the testis. There is no known pathology, but sexual irregularity or excess is an antecedent factor.

2. With lesions in the epididymis or body of the testis. Small masses of fibrous tissue are found in

the globus minor following gonococcal epididymo-orchitis.

3. With lesions in the adnexa of the testis, especially varicocele.

In all types there is a marked neurotic element.

Signs and Symptoms.—Constant tenderness of the testis, which is exaggerated during the painful paroxysms. Coitus sometimes relieves, in other cases aggravates the pain.

Treatment.—Any organic defect—e.g., hydrocele—must be operated on, but orchidectomy is to be avoided, owing to the tendency to mental changes in the highly strung patients who are the subjects of this disorder.

THE SPERMATIC CORD AND TUNICA VAGINALIS

Hydrocele.—A hydrocele is a collection of fluid other than pus or blood within the confines of the processus vaginalis. It may be (1) primary, (2) secondary.

I. PRIMARY HYDROCELE.—The following varieties are recognized:

(1) **Idiopathic Vaginal.**—This is confined to the tunica vaginalis and may be (a) acute, (b) chronic. The former is relatively rare and is generally associated with rheumatic or pneumococcal infections. The cavity is distended with inflammatory lymph. Chronic hydrocele is the common type and its cause is unknown. It is possible that it is really secondary to a low-grade inflammation in the testis or epididymis, but by many it is regarded as a passive effusion. Elderly men are most often affected, but it is not unusual in children or young adults.

Pathological Anatomy.—The fluid closely resembles blood serum and is straw-coloured, although occasionally discoloured with blood or containing cholesterin crystals. The tunical wall is often thinned, but may be much thickened locally or generally. Fibrosis and calcification of the wall often develop in old-standing cases, and occasionally the cavity becomes divided up by fibrous septa into loculi. In

the later stages the testis becomes atrophic from pressure; more often the epididymis becomes separated widely from the body of the testis and the vasa efferentia are compressed.

Signs and Symptoms.—There is no pain, but the bulk and weight of the hydrocœle may cause discomfort, while the burying of the penis may interfere with micturition. The tumour itself is pear-shaped but well delineated above, which distinguishes it from hernia. The swelling is translucent, unless calcification of the wall or hæmorrhage into the lumen has occurred. The hydrocœle is under normal conditions in front of the testis, but the reverse may be observed occasionally (10 per cent.).

Complications.—(1) Rupture, traumatic or spontaneous. This is characterized by sharp pain, followed by transformation of the tense elastic swelling into one which is diffuse and œdematous. (2) Inflammation which may go on to suppuration. (3) Hæmatocœle (see p. 618).

Treatment—(a) *Palliative.*—Regular tapping by means of a trocar and cannula. This can be followed up in thin-walled sacs by injection of irritant fluids—e.g., sodium morrhuate—with the object of obliteration of the sac by destruction of the endothelium.

(b) *Radical.*—There are two methods: (i.) Excision of the parietal layer of the tunica—this is suitable for thick-walled sacs; (ii.) eversion of the sac after evacuation of its contents—this is to be reserved for thin-walled sacs, as otherwise recurrence is to be feared.

(2) *Infantile Hydrocœle.*—The processus vaginalis is closed at the internal ring, but the remainder distends with fluid. It appears soon after birth. The swelling is irreducible and translucent. Sometimes this hydrocœle disappears spontaneously, and therefore operation (preferably by the eversion method) can be safely postponed until the child is a year or two old.

(3) *Bilocular Hydrocœle.*—Here, in addition to the infantile type of hydrocœle sac, there is an interstitial sac. Removal by dissection is desirable.

(4) **Encysted Hydrocœle of the Cord.**—The fluid develops in an unobliterated part of the funicular



1
Idiopathic vaginal hydrocœle.



2.
Infantile hydrocœle.



3.
Bilocular hydrocœle.



4.
Encysted hydrocœle of the cord.



5.
Congenital hydrocœle.



6.
Encysted hydrocœle (cyst) of
epididymis.

FIG. 58.—ILLUSTRATING VARIETIES OF HYDROCŒLE.

process. The swelling is rounded and well defined, and is curable by excision, though in children it may disappear spontaneously.

(5) **Congenital Hydrocœle.**—The fluid collects in the unobliterated processus vaginalis, which, however, communicates with the peritoneal cavity by a small pore. There may be a slight impulse on coughing, but the swelling empties and refills much slower than is the case with a hernial sac. Operative treatment is as for a congenital hernia.

(6) **Diffuse Hydrocœle of the Cord.**—This is not a true hydrocœle, as it does not originate in the processus vaginalis. An ill-defined swelling containing blood serum appears among the cremasteric fibres. The condition is very rare, the cause obscure.

2. **SECONDARY HYDROCELE.**—May be acute or chronic.

(1) **Acute.**—This follows injuries or acute inflammation of the testis, the effusion being typically inflammatory and unlike that of the idiopathic type of primary hydrocœle. It usually resolves, but if suppuration follows, drainage may be needed.

(2) **Chronic.**—This is seen in association with gummatous orchitis, tuberculous epididymitis, etc. The treatment is that of the underlying primary lesion.

Hæmatocœle.—An extravasation of blood into the tunica vaginalis; it is often but not invariably preceded by hydrocœle. The following varieties are distinguished:

1. **Spontaneous.**—There is no history of injury and the blood appears to arise from bursting of a blood-vessel.

2. **Traumatic.**—In the process of tapping a hydrocœle, as a result of the sudden withdrawal of fluid leading to bursting of a vessel, or following direct trauma. Torsion of the testis may also lead to hæmatocœle.

3. **Malignant.**—A rapidly growing malignant growth ulcerates into the tunica vaginalis, and bleeding into the sac may follow.

Signs and Symptoms.—There are two classical types: (1) acute, with a definite history of trauma, particularly in patients with hydrocœle; (2) chronic—the onset here is insidious without definite history

of injury. It is often very slow in its development.

The absence of translucency is characteristic, and there is none of the elasticity so often felt in hydrocœle. The cord is thickened, and on tapping the swelling a dark fluid containing altered blood is withdrawn. The tunical cavity contains blood clot and altered fluid blood, and its walls are in long-standing cases much thickened. Secondary atrophic changes in the testis supervene in old-standing cases.

Diagnosis from neoplasm is often very difficult in the absence of a definite history of injury. In all cases of doubt an incision will clear up the issue.

Treatment.—The choice lies between:

1. *Incision.*—Suitable for recent cases without any preceding hydrocœle.

2. *Excision* of tunica vaginalis.

3. *Orchidectomy* when the sac is very thick-walled and the testis atrophied.

Varicocœle.—A varicose condition of the veins of the pampiniform plexus, rarely extending upwards beyond the internal ring. The veins of the scrotum and penis may share in the varicose process. Either side or both may be affected, but the left is much the commoner. It is a disability of adolescence and the cause obscure, except in association with obstructive lesions such as malignant disease of the kidney, when it is more likely to be of acute onset and in older men.

The veins are dilated, tortuous, lengthened and increased in number; their walls are thickened and clots may develop in the lumina. It is said that atrophy of the testis may follow, but this is open to grave doubt.

Signs and Symptoms.—The patient is usually unaware of any abnormality until it is pointed out during systematic medical examination for entry into one of the services. It is usual to reject a candidate for such an occupation if he has a varicocœle, or to insist on operative treatment. Neither is justifiable in the vast majority of cases, and many instances of

neurasthenia and neuralgia testis are attributable to this official ignorance.

Treatment.—Unless the condition is advanced, it should be ignored. A suspensory bandage is helpful if dragging or aching is complained of, though everything possible should be done to reassure the patient that his varicocœle is of no vital importance. If operation is insisted on to placate officialdom, short segments of the main veins only should be excised; even if skilfully conducted, this may aggravate rather than abolish the patient's symptoms, and hydrocœle may develop as a sequel. Injection of 5 per cent. sodium morrhuate into the pampiniform plexus under local anæsthesia gives good results with less likelihood of unpleasant sequelæ.

INDEX

- a*-particles, 77
- Abdomen*:
 - affections of, 406
 - injuries of, 406
- Abdominal wall*, 406
 - congenital defects of, 408
 - diseases of, 408
 - injuries of, 406
- Abdomino - perineal excision of rectum, 539
- Abducens nerve, injury to, 107
- Abduction fracture, neck of femur, 228
- Abnormalities, congenital, of external ear, 341
 - of tongue, 306
- Abscess*:
 - acute, 8
 - signs and symptoms of, 9
 - treatment by Hilton's method, 11
 - alveolar, 296
 - amœbic, of liver, 493
 - appendicular, 487
 - Bezold's, 345
 - Brodie's, 131
 - cerebral, 285
 - chronic, 10
 - cold, 40
 - extradural, 284, 347
 - in Pott's disease, 263
 - intrapelvic, 152
 - ischio-rectal, 525
 - mammary, 394
 - of lung, 381
 - of scalp, 270
 - pelvi-rectal, 520
 - pelvic, 413
 - perianal, 520
 - pericolic, 470
 - perinephric, 551
 - peritonsillar, 329
- Abscess (continued)*:
 - periurethral, urinary, 601
 - prostatic, 580
 - psoas, 263
 - retropharyngeal, 333
 - spinal.(posterior), 262
 - subdural, 287
 - subhepatic, 414
 - sublingual, 309
 - subphrenic, 413
 - tropical, of liver, 493
 - tuberculous, 10, 40
- Acetabular disease, tuberculous, 152
- Acetabulum, fracture of, 230
 - travelling, 152
- Acetylcholine, in ileus, 412, 427
- Achalasia, of cardia, 336
- Acholic jaundice, 513
- Achondroplasia, 137
- Acoustic nerve tumour, 288
- Acromegaly, 138
- Acromion process, fracture of, 208
- Actinomycosis*, 42
 - of appendix, 491
 - of jaw, 299
 - of lung, 383
- Adamantinoma, 289, 300, 302
- Adductor longus, rupture of, 116
- Adenitis (*see* Lymphadenitis)
- Adeno-carcinoma:
 - of large intestine, 469
 - papilliferous, of colon, 469
 - of rectum, 535
 - of thyroid, 359
- Adenoids, 327
- Adenoma*, 69
 - cystic, 70
 - malignant, of thyroid, 359
 - mammary, 398
 - palatal, 321

- Adenoma (continued):*
 parathyroid, 139
 rectal, 534
 sebaceous, 123
 suprarenal, 563
 toxic, of thyroid, 361
Adenomata, multiple, of colon, 468
Adenomyoma, 65
Adrenalin in arrest of hæmorrhage, 56
 in shock, 54
 test, Loewe's mydriasis, 507
Adventitious bursæ, 119
Adynamic ileus, 483
Agglutinins, 13
Agranulocytosis, 16
Air embolism, 92
 hunger, 55
 passages, affections of, 367
 foreign bodies in, 367
 wounds involving the, 349
Albee's operation in Pott's disease, 264
 in spondylolisthesis, 167
Alcohol injections in facial tic, 108
 in neuralgia, 105
 in tic douloureux, 106
Alcoholic traumatic delirium, 51-52
Alderman's gait in Pott's disease, 264
Alexia, 289
Alveolus, burrowing epithelioma of, 197
 carcinoma of, 297
 sarcoma of, 297
Amastia, 392
Ammonium urate, in renal calculi, 554
Amnesia, after head injury, 279
Amnioplastin in nerve suture, 103
Amputation neuroma, 66
Amyloid disease, 11
Anæmia, chronic hæmolytic, 513
 splenic, 512
Anaerobes, in gas gangrene, 192
Anæsthesia, 3
 spinal, in ileus, 427
Anæsthetic leprosy, 42
Anal canal, affections of the, 515
 carcinoma of, 537
Anal fissure, 530
Anal hæmatoma, 527
Anastomotic ulcer, 449
Aneurysm:
 abdominal, 89
 aortic, tracheal tug in, 88
 by anastomosis, 88
 causes of, 84
 cirroid, of scalp, 270
 common carotid, 87
 differential diagnosis of, 85
 diffuse traumatic, 81
 dissecting, 84
 excision of sac for, 86
 false, 84
 fusiform, 84
 Hunter's operation for, 87
 intracranial, 88
 intra-orbital, 88
 ligation in, 87
 Matas's operation for, 87
 medical treatment of, 86
 of axillary artery, 89
 popliteal, 89
 results of, 85
 rupture of, 86
 sacculated, 84
 signs and symptoms of, 85
 subclavian, 89
 suppuration in, 86
 surgical treatment of, 86
 true, 84
 varicose, 83
Aneurysmal varix, 83
Angina, Ludwig's, 19
 Vincent's, 332
Angio-fibroma, naso-pharyngeal, 328

- angioma*, 63
 of tongue, 311
 plexiform, 63
 angular kyphosis, 166
ankle:
 capsular injuries of, 244
 dislocations of, 244
 fractures of, 241-243
 recurrent dislocation of, 244
 tuberculosis of, 154
 ankyloglossia, 307
 ankylosis, 159-160
 no-rectal fistulae, 521
Anthrax, 27
 Antibacterial sera, 13
 antias-gangrene serum, 13,
 193
 Antitetanic serum, 13, 25
 Antitoxic sera, 13
 Antritis, maxillary, 301
 Antrum, mastoid, drainage
 of, 345
 Anuria, calculous, 556-7
 Anus, imperforate, 515
 Aphasia in cerebral tumours,
 289
 Apophysitis of os calcis, 132
Appendicitis, 485
 acute obstructive, 485
 acute simple, 485
 chronic, 490
 complications of, 489
 abscess, 487, 489
 paralytic ileus, 489
 pelvic abscess in, 489
 pyelophlebitis in, 489
 subphrenic abscess,
 489
 diagnosis of, 487
 etiology of, 485
 operation for, 486
 pathology of, 485
 signs and symptoms of,
 486
 treatment of, 488
 appendicostomy for ulcera-
 tive colitis, 463
 appendicular abscess, 487
 colic, 490
 dyspepsia, 490
- Appendix*:
 actinomycosis of the, 491
 affections of the, 489
 carcinoid of, 492
 carcinoma of, 491
 empyema of, 486
 hernia of, 421
 mucocœle of, 492
 tuberculosis of, 491
 Argyll-Robertson pupil, 158
 Arsenical treatment in syphi-
 lis, 36
 Arterial embolism, 90
 hæmorrhage, primary, 58
 reactionary, 59
 secondary, 59
 thrombosis, 188
Arteries:
 contusion of, 81
 diseases of, 81-83
 penetrating wounds of,
 82
 rupture of, 81
 Arteriography, 291
 Arterio-venous wounds, 82
 Arteritis, 83
 Arthralgia in syphilis, 155
Arthritis, acute, 145
 chondro-, 155
 gonococcal, 148
 gouty, 147
 gummatous, 155
 neuropathic, 157
 pneumococcal, 148
 pyæmic, 148
 rheumatoid, 147
 tuberculous, 149-155
 typhoid, 148
 Artificial pneumothorax, 383
 Ascites, 418
 Aseptic traumatic fever, 51
 Asphyxia, traumatic, 374
 Astereognosis in cerebral tu-
 mour, 289
 Astragalus:
 dislocation of, 247
 fracture of, 247
 Astrocytoma, 73
 Atheroma, 83
 Atlas, injuries of, 252

- Atrophic scirrhus of breast, 403
 Auditory nerve, injuries to, 108
 Autogenous vaccines, 14
 in chronic gonorrhœa, 29
 Automatic bladder, 577
 Avascular bone necrosis, in fractures, 197, 246
 Avertin, basal anæsthesia with, 3, 363
 Avulsion, phrenic (*see* Evulsion, phrenic)
 Axillary artery, aneurysm of, 89

 β -particles, 77
Bacilli, 27
Bacteria in inflammation, 5
 Bacteriæmia, 130
 Bacterial vaccines, 14
 Baker's cyst, 146
 Balanced traction, in fracture, 199
 Balanitis, gonorrhœal, 30
 Balano-posthitis, 603
 Balkan frame, in fractured femur, 232
 Ballance's method facial nerve graft, 108
 Banti's syndrome, 512
 Barbiturates, pre-operative use of, 2
 Basal anæsthesia with avertin, 3, 363
 celled carcinoma, 71
 metabolic rate (B.M.R.), in thyrotoxicosis, 361, 362
 Base of skull, fractures of the, 272
 Basedow's disease, 361
 Bassini's operation, hernia, 432
 Bazin's disease, 121
 'Beam' therapy, 77
 Bedsores, 189
 Bee stings, 47
 Bell's palsy, 107
 Benign giant-cell tumour, 66
 of bone, 140
 of jaws, 299
 Bennett's fracture-dislocation, 224
 Bezold's abscess, 344
 Biceps cubiti, rupture of, 116
 Bicoudé catheter for prostatic enlargement, 586
 Bier's artificial hyperæmia, 18, 127
 Bile ducts, carcinoma of, 506
 Bile enemata, 427
 Bilharzia, antimony tartrate in, 570
 in rectal neoplasms, 534
 of the bladder, 569
 Bilharzial proctitis, 518
 Biliary calculi, 500
 colic, 502
 fistulæ, 505
 BIPP (bismuth, iodoform and paraffin-paste), 11
 Birth injuries, intracranial hæmorrhage in, 279
Bladder:
 affections of, 564
 bilharzia of, 569
 congenital abnormalities of, 564
 extroversion of, 564
 foreign bodies in, 566
 functional derangement of, 576
 hernia of, 421
 injuries of, 565, 566
 neoplasms of, 570
 B.L.B. oxygen mask in shock, 54
 in thyrotoxicosis, 365
 Bleeding, arterial, 55
 capillary, 55
 venous, 55
 Blood cysts, 81
 in long bones, 140
 of breast, 398
 of neck, 354
 Blood grouping, 57
 Blood transfusion, 57

- Böhler-Braun splint, 233
 Böhler's method in fractured os calcis, 245
 Boils, 16
Bone, caries of, 126
 cario-necrosis of, 127
 fibrocystic disease of, 140
 in sacro-iliac strain, 254
 inflammation of, 126
 hydatid disease of, 140
 localized cysts of, 140
 necrosis of, 126
 rarefaction of, 126
 sclerosis of, 127
 sequestrum, 129
 syphilis of, 134
 tuberculosis of, 133
 tumours of, 140
 Bone grafts, 200, 201
 in Pott's disease, 264
 Boring epithelioma of alveolus, 297
 Bougie, filiform, in retention of urine, 579
 Harrison's whip, 579
 Hurst's mercury-loaded, 337
 Plummer's perforated, 338
 Bow-legs, 176
 Brace, Taylor's spinal, 264
 Brachial plexus, injuries to, 109
 Brachialis anticus, ossification in, 117
 Brain abscess, 285
 Branchial carcinoma, 350
 cysts, 352
 fistulæ, 351
 Braun's splint, 232, 241
Breast, the, 392
 atrophic scirrhus of, 403
 blood cysts of, 398
 cancer, colloid, of, 403
 cancer *en cuirasse* of, 405
 carcinoma of, 399
 diagnosis of, 404
 irradiation in, 405
 palliative treatment of, 405
Breast, carcinoma of, lymphatic extension in, 400
 pathology of, 400
 prognosis in, 405
 treatment of, 404
 varieties of, 402
 chronic abscess of, 396
 cystadenoma of, 399
 cystic sarcoma of, 399
 cysts of, 397
 diffuse hypertrophy of, 392
 duct papilloma of, 399
 excision of, 404
 exploration of, 404
 fibro-adenoma of, 398
 Gaillard-Thomas's operation on, 398
 galactocœle of, 397
 injuries of, 392
 malformations of, 392
 neoplasms of, 398
 Paget's disease of, 403
 sarcoma of, 399
 supernumerary, 392
 tuberculosis of, 397
 Breathing exercises with Wolff's bottles, 379
 Brilliant green in burns, 48
 Brodie's abscess, 131
 Bronchiectasis, 381
 Bronchus, foreign bodies in, 368
 Browne's splint for club-foot, 178
 Brüning's tube, 368
 Bryant, 'gallows' method for fractured femur, 232
 Bryant's triangle, 227
 Bubonocœle, 428
 Buller's shield in gonococcal conjunctivitis, 31
 Bunion, 182
 Burns, 47
 Dupuytren's classification of, 47
 treatment of, 48-49
 Bursæ, diseases of, 119
 adventitious, 119

Bursæ, special, 120
 tumours of, 120
 Bursitis, 119
 gouty, 120
 syphilitic, 120
 tuberculous, 120

Cachexia strumipriva, 366
 Cæcostomy in ulcerative colitis, 463

 in malignant disease of colon, 471

Cæcal neoplasms, 470

'Calciferol' in tetany, 365

Calcium carbonate in renal calculi, 554

 oxalate in renal calculi, 554

 phosphate calculi, 555

Calculus anuria, 556

Calculus:

 biliary, 500
 pancreatic, 511
 prostatic, 580
 renal, 553-556
 salivary, 315
 ureteric, 558
 urethral, 596
 vesical, 573

Callus, nerve involvement in, 104

Calvé's disease, 132

Cancer:

 chimney-sweep's, 606
 colloid, of breast, 403
 en cuirasse, 402
 encephaloid, of breast, 403
 scirrhus, of breast, 402

Cancerophobia, 314

Cancrum oris, 193

Capillary hæmorrhage, 55
 nævus, 63

Capitellum, fracture of, 214

Carbon dioxide snow for nævus, 63

Carbuncle, 17

 renal, 551

Carcinoid of the appendix, 492

Carcinoma, 70

 of alveolus, 297

Carcinoma (continued):

 of appendix, 491
 of ascending colon, 469

 470

 basal-celled, 70

 of bile ducts, 506

 of bladder, 571

 of brain (metastatic 289

 branchial, 350

 of breast, 399-406

 of cæcum, 470

 of colon, 469

 columnar-celled, 72

 of descending colon, 470

 duct, of breast, 403

 of duodenum, 459

 gall-bladder, 505

 glandular, 72

 of hepatic flexure, 470

 of large intestine, 469

 of larynx, 372

 of lips, 294

 of liver, 495

 of lung, 384

 medullary, 72

 of œsophagus, 338

 of pancreas, 510

 of pelvic colon, 470

 of pharynx, 333

 of prostate, 589

 radium for, 77

 of rectum, 535-540

 renal, 560

 sebaceous, 123, 124

 secondary, in bones, 143

 simplex, of thyroid, 559

 of skin, 123

 of skull, secondary, 281

 spheroidal-celled, 72

 of spine, secondary, 267

 squamous-celled, 70, 12

 of stomach, 453

 teletherapy in, 77

 of testis, 613

 of tongue, 311

 varieties of, 70

Cardiospasm, 336

Caries of bone, 126

sicca, 151

- Caries of spine (*see* Pott's Disease, p. 261)
 Cardio-necrosis, 127
 Carotid body, tumours of, 351
 Carpo-pedal spasms, in tetany, 365
 Carpus, fracture - dislocation of, 224
 Carrel-Dakin tubes in acute arthritis, 146
 Cartilage, knee, torn semi-lunar, 234
 Caseation, 40
 Casoni intradermal test, 81, 496
 Casselberry nasal packer, 323
 Catgut, preparation of, 4
 Catheter, bicoudé, for prostatic enlargement, 586
 coudé, for prostatic enlargement, 586
 de Pezzer's self-retaining, 600
 fever, 549, 593
 'life,' 586
 Catheterization in prostatic enlargement, 586
 Catheters in spinal fracture, 253
 Causalgia, 102
 Cavernous angioma (naevus), 63
 lymphangioma, 64
 sinus, infective thrombosis of, 287
 Cellophane masks, 4
 Cell-nests in epithelioma, 71
 Cellulitis, 18
 of the neck, 19
 of the orbit, 19
 of the scalp, 18
 of the scrotum, 606
 Cellulo-cutaneous erysipelas, 22
 Cementoma, 300
 Cephalocele, 282
 Cerebellar fits, 290
 Cerebello - pontine tumours, 290
 Cerebral compression, 275-276
 Cerebral concussion, 273
 Cerebral irritation, 274
 Cerebral laceration, 276
 Cerebro-spinal fluid, chemistry of, in cerebral tumours, 291
 detection of, 272
 escape of, in fractured skull, 272
 in spinal tumours, 269
 Cerumen in ear, 342
 Cervical caries, reflex wry-neck in, 263
 Cervical fascia in torticollis, 161
 Cervical plexus, injuries to, 108
 Cervical rib, 162
 Cervical spine, injuries to, 251
 Chancre, hard, 32
 Hunterian, 32
 of lip, 294
 soft, 38
 Chancroid, 38
 Charcot's intermittent hepatic fever, 502
 joints, 157
 in syphilis, 155
 Chaulmoogra oil, 42
 Chemical analysis in urology, 541
 Chemotherapy, 1, 15
 Chevalier Jackson's tube, 368
 Cheyne-Stokes breathing, in intracranial tumours, 290
 Chimney-sweep's cancer, 606
 Choked disc, 290
 Cholangitis, suppurative, 493
 Cholecystitis, 497-499
 Cholecystography, 503
 Choledochus cyst, 496
 Cholelithiasis, 500-503
 Cholesteatoma, 289
 in middle-ear disease, 347
 Cholic acid in cancerogenesis, 61
 Chondro-arthritis in acquired syphilis, 155

- Chondroma, 53
 Chordee, 30
 Chordoma, 67
 sacro-coccygeal, 261
 Choriocarcinoma, 75
 Chorionepithelioma, 75
 Choroido-retinitis, syphilitic,
 34
 Chromocystoscopy, 541
 Chronic intestinal obstruction,
 484
 Chylous ascites, 418
 Circumflex nerve, injuries to,
 109
 Cirsoid aneurysm, 270
 Citrate method of blood
 transfusion, 57
 sodium in phlebitis, 92
 Clairmont's operation, 211
Claviceps purpurea (ergot fun-
 gus), 192
 Clavicle, dislocation of, 207
 fracture of, 206
 Claw-foot, 182
 Cleft palate, 319
 Clicking hip, 174
 jaw, 304
Clostridium, œdema-tiens, 192
 septicum, 192
 tetani, 23
 Welchii, 19, 102
 Club foot, 177
 hand, 170
 Clutton's joints, 155
 Coccydynia, 267
 Coccyx, fracture of, 257
 Cock's peculiar tumour, 125
 Cod-liver oil in tuberculosis,
 41
 in rickets, 137
 Coeliac plexus, 114
 Coley's fluid for sarcoma, 69
Colic:
 appendicular, 490
 biliary, 502
 intestinal, 473
 renal, 555
 Colitis, ulcerative, 462
 Collapse therapy, 383
 pulmonary, 376
 Colles' fracture, 220
 Law, 37
 Colloid cancer, of breast, 400
 of rectum, 536
Colon:
 carcinoma of, 469
 congenital dilatation of,
 460
 diverticula of, 463
 tuberculosis of, 465
 Colostomy in cancer of rec-
 tum, 540
 in imperforate anus, 516
 in malignant disease of
 large intestine, 472
 in rectal stricture, 519
 Columbia paste in radium
 therapy, 78
 Common carotid, aneurysm
 of, 87
 Complement fixation test,
 syphilis, 33
 Complicated dislocation, 204
 Composite odontoma, 301
 Compound dislocation, 204
 Compound follicular odon-
 toma, 300
 Compound fractures, 194
 Compound palmar ganglion,
 118
 Compression, cerebral, 275
 fracture, of spine, 256
 of cord, 265
 of nerves, 104
 Concretion, faecal, 486
 Concussion, cerebral, 273
 Condylomata, 34
Congenital abnormalities:
 adenoma of the post-anal
 gut, 260
 chronic hæmolytic anæmia, •
 513
 contracture of fingers, 170
 cysts of the neck, 352
 diaphragmatic hernia, 438
 dilatation of colon, 460
 dislocation of the hip, 170
 displacements of the kidney,
 543, 544
 elevation of the scapula, 167

Congenital abnormalities (continued):

- elevation of external ear, 341
- hydrocele, 618
- hydrocephalus, 283
- hypertrophic pyloric stenosis, 452
- macrocheilia, 295
- macrostoma, 296
- malformations of kidney, 543
 - of œsophagus, 335
- mandibular cleft, 296
- microstoma, 296
- inguinal hernia, 428
- pyloric stenosis, 452
- rectal stricture, 518
- stricture, urethral, 594
- talipes, 176
 - of tongue, 306
- umbilical hernia, 435
- Congenital syphilis, 37
- Conjunctivitis, gonococcal, 30
- Connective tissue tumours, 63
- Constriction groove, in strangulated hernia, 427
- Contracture, congenital, of fingers, 170
 - Dupuytren's, 168
 - Volkman's ischæmic, 167
- Contused wounds, 43
- Contusion:*
 - of arteries, 81
 - of lung, 374
 - of nerves, 101
- Cord, encysted hydrocele of, 617
- Cord, spinal, compression of, 252
 - destruction of, 252
 - diseases of, 267
 - tumours of, 268
- Corn, 122
- Corneal opacities (syphilis), 38
- Coronary thrombosis, 386
- Coronoid process of ulna, fracture of, 215
- Courvoisier's Law, 510
- Cowper's gland, inflammation of, 30

- Coxa plana, 171
- Coxa valga, 174
 - vara, 171, 173
- Cracked lips, 293
- Crackling, egg-shell, 140, 297
- Cranial nerves, injuries to, 105
- Cranio-pharyngioma, 289
- Cranio-tabes, 38, 135, 281
- Cranium, affections of the, 269
- Crédé's method of prophylaxis, 31
- Crepitus, in fracture, 198
- Cretinism, 366
- Crohn's disease, 466
- Crucial ligaments of knee, rupture of, 235
- Crush syndrome, 53
- Crutch palsy, 104
- Crutch pressure on nerves, 109
- Cubitus valgus, 167
 - varus, 167
- Cupping, 6
- Curietherapy, 77
- Curvature, angular, of spine, 262
- Curvatures, compensatory, of spine, 164
- Cut-throat, 348
- Cyclopropane, 3
- Cysts,* 79
 - acquired, of the neck, 353
 - Baker's, 80
 - blood, 81
 - of breast, 398
 - in long bones, 140
 - of neck, 354
 - of bone, localized, 140
 - branchial, 352
 - of breast, 397
 - bursal, of neck, 354
 - choledochus, 496
 - classification of, 79
 - congenital, of the neck, 352
 - degeneration, 81
 - of breast, 354
 - dental, 297
 - dentigerous, 300
 - dermoid, 79
 - of breast, 398

Cysts, dermoid, sacro-coccygeal, 260
 of scalp, 270
 of tongue, 311
 embryonic, post-anal, 80
 thyroglossal, 353
 of epididymis, 614
 of Gartner's duct, 80
 hydatid, 80
 of breast, 398
 of kidney, 562
 of liver, 495
 of neck, 354
 involution, of breast, 397
 of liver, 495
 lymphatic, breast, 397
 meningeal, 260
 mesenteric, 418
 mucous, of lips, 294
 of Müllerian duct, 80
 of neck, blood, 354
 branchial, 352
 bursal, 354
 congenital, 352
 cystic hygroma, 352
 degenerative, 354
 distension, 354
 hydatid, 354
 sebaceous, 353
 serous, 354
 thyroglossal, 353
 of processus vaginalis, 615
 pancreatic, 509
 parasitic, 79
 paroöphoronic, 80
 parovarian, 80
 in polycystic kidney, 361
 renal, 361
 dermoid, 361
 multiple, 361
 retention, 79, 80
 of breast, 397
 sebaceous, 80
 of breast, 398
 of scrotum, 606
 of skin, 124
 serous, breast, 79
 of spleen, 514
 suprasellar, 289
 synovial, 79, 80

Cysts, testis, 614
 thyroglossal, 353
 thyroid, 357
 urachal, 408, 565
 vitello-intestinal, 408
 Wolffian duct, 80
 Cystadenoma, of breast, 399
 Cystic adenoma, 81
 Cystic disease of testis, 613
 hygroma, 352
 mastitis, 396, 397
 sarcoma, of breast, 399
 Cystine calculi, 554
 Cystitis, 566
 acute, 567
 chronic, 568
 tuberculous, 569
 Cystoscopy in prostatic enlargement, 585
 in renal colic, 555
 in urological diagnosis, 541,
 Cystotomy in spinal fracture, 253
 Dactylitis, syphilitic, 135
 tuberculous, 133
 Dakin's solution, 145
 Dalrymple's ocular sign, 362
 Deaf-mutism, in cretinism, 366
Deformities, 160
 of the lower extremity, 170
 of the spine, 163
 of the upper extremity, 167
 Deformity in Pott's disease, 262
 Delayed union of fractures, 196
 treatment of, 200
 Delirium, 51
 Depressed fracture of skull, 272
 Derangements, internal, of knee, 234
 Dermoid cysts, 79
 implantation, 125

- Descent of testis, imperfect, 607
- Desmoid tumour, 408
- Detoxicated vaccines, 14
- Deviation of the nasal septum, 324
- Diabetes and carbuncle, 17, and chronic neuritis, 104
- 'Dial,' 2
- Diaphragm, wounds of, 375
- Diaphragmatic hernia, 438
- Diathermy:*
 in carcinoma of larynx, 373
 in cavernous nævus, 63
 in chronic synovitis, 146
 in osteo-arthritis, 157
 in painful sacralization, 266
 in rectal neoplasms, 535
 in transurethral resection, 588
 short wave, 18
- Diet, ketoënic, 548
- Dietl's crisis, 544
- Di-iodo-tyrosine therapy, 363
- Dilatation, in carcinoma of œsophagus, 339
 in fibrous stricture of œsophagus, 338
 of the colon, congenital, 460
 of the stomach, acute, 450
 retrograde, in stricture of œsophagus, 338
 in urethral stricture, 599
- Dinner - fork deformity in Colles' fracture, 220
- Dislocations,* 204
 after-treatment of, 205
 of ankle, 241
 of astragalus, 247
 of carpus, 224
 of clavicle, 207
 of elbow, 217
 of hip, 230
 congenital, 170
 of knee, 237
 of lower jaw, 303
 of metacarpals, 227
 of patella, 257
 of phalanges, 227
- Dislocations,* recurrent, of
 shoulder, 211
 of semilunar, 223
 of shoulder, 210
 of spine, 250
 subastragaloid, 248
 of tendons, 116
 of thumb, 224
 varieties of, 204
 of wrist, 223, 224
- Divarication of the recti, 437
- Diverticula of the colon, 463
- Diverticulitis, 463
- Diverticulosis, 463
- Diverticulum of the bladder, 575
 of the duodenum, 456
 Meckel's, 459
 pressure, of pharynx, 331
 traction, of œsophagus, 335
- Dmelcos vaccine, 39
- Drainage, cannula, in liver abscess, 494
 of empyema, Sprengel's pump in, 379
- Dressings, sterilization of, 5
- Drip method, continuous, normal saline, 54
- Dry gangrene, 188
- Ducrey's bacillus, 33, 38
- Duct carcinoma of breast, 403
- Duct, Mullerian, cysts of, 80
- Duct papilloma of breast, 399
- Duct, thoracic, wounds of, 350
- Duodenal fistula, 459
- Duodenal peritoneal fossæ, 475
- Duodenal ulcer, 457, 459
- Duodeno-jejunal flexure, torn, 407
- Duodenum,* affections of, 456
 carcinoma of, 459
 diverticulum of, 456
 rupture of, 457
- Dupuytren's classification of
 degrees of burns, 47
 contracture of fingers, 168
 fracture, 242

- Dysenteric abscess of liver, 493
 Dyspepsia, appendicular, 490
 ' flatulent, 501
 Dyspeptic ulcer of the tongue, 309
 Dysphagia, 334

 Ear, affections of the, 341-342
 Earache, 343
 Ecchondroses in osteo-arthritis, 156
 Ectopia testis, 607
 vesicae, 408, 564
 Eczema of ear, 341
 of nipple, 393
 rubrum, 23
 with varicose veins, 94
 Eighth nerve, injuries to, 108
 Elastic stockings in varicose veins, 95
 supports in phlebitis, 92
 Elbow, dislocation of, 217
 fracture dislocation of, 218
 injuries of, 214
 sprains of, 218
 tenuis, 218
 traumatic synovitis of, 218
 tuberculosis of, 151
 Electro-coagulation for bladder tumours, 570
 in brain surgery, 292
 Electro-encephalography, 291
 Electrolisis for capillary naevi, 63
 for intra-orbital aneurysm, 88
 Elephantiasis, 98
 of scrotum, 607
 Eleventh cranial nerve, injury to, 108
 Elliott's machine in gonorrhoea, 32
 Embolotomy in gangrene, 191
 pulmonary, 385
 Embolism, air, 92
 mesenteric, 483
 Embolus, infective, 90
 pulmonary, 385

 Emetine in dysenteric proctitis, 517
 in tropical abscess, 494
 Emphysema, surgical, 375
 Empyothorax in tetanus, 24
 Empyema, of appendix, 486
 of gall-bladder, 498
 thoracis, 377-379
 Encephalocle, 282
 Encephalography, 291
 Encephaloid cancer, of breast, 403
 Endarteritis obliterans, 83
 Endemic cretinism, 366
 Endo-aneurysmorrhaphy, Matar's obliterative, 87
 Endotheloid cells, in tuberculosis, 40
 Endothelioma, 67
 of tongue, 311
Entamoeba histolytica, 493
Enterobius vermicularis in pruritus ani, 533
 Enterocoele, 420
 Enteroliths, obstruction by, 478
 Enterospasm, 483
 Enuresis, essential, 577
 'Envelope' treatment of burns, 49
 Epicritic sensation, loss of, 102
 Epididymis, cysts of the, 614
 Epididymitis, 30
 syphilitic, 612
 Epididymo-orchitis, 609
 Epilepsy in intracranial tumours, 289
 Jacksonian, 280
 traumatic, 280
 Epiphyseal fracture, 195
 Epiphyseal (juxta-) strain, 195
 Epiphysitis, 126, 131
 • syphilitic, 135
 Epiplocle, 420
 Epispadias, 594
 Epistaxis, 322
 Epithelial odontoma, 300
 tumours, 69

- Epithelioma*:
 of alveolus, 297
 of neck, 350
 of palate, 321
 radium therapy for, 71
 of scalp, 270
 of scrotum, 606
 of skin, 124
 of testis, 613
 of tonsil, 331
Epulis, 297
Equino-valgus, talipes, 180
Equino-varus, talipes, 177
Equinus, talipes, 179
Erb-Duchenne paralysis, 109
Ergot, gangrene due to, 192
Erysipelas 22
 of the scalp, 270
Erythema nodosum, 23
 pernio, 122
 solare, 23
 syphilitic, 33
Eserine sulphate in ileus, 427
 'E.S.H.' in burns, 49
Esmarch's bandage as tourniquet, 59
Essential enuresis, 577
 thrombocytopenia, 513
Estlander's thoracoplasty, 380
Ethmoiditis, 327
Eucortone in shock, 54
Eumydrin, in congenital pyloric spasm, 452
Evipan, 3
Evulsion, phrenic, 383
Ewing's tumour, 141
Excision of wounds, 46
Exomphalos, 433
Exophthalmic goitre, 361
Exophthalmos, pulsating, 88
 in cavernous sinus thrombosis, 287
Exostoses, 67
 of ear, 342
External popliteal nerve, injury to, 112
External proctotomy, 519
External urethrotomy, 600
Extra-dural abscess, 284, 347
 hæmorrhage, 278
 Extra-periosteal fibro-sarcoma, 143
Extra-pleural pneumothorax, 384
Extravasation of urine, 601
Extroversion of the bladder, 564
Facial cleft, oblique, congenital, 296
 nerve, injury to, 107
 paralysis, 107
 tic, 108
Facies Hippocratica, 410
Facio-hypoglossal anastomosis, 107
Fæcal accumulation, 478
 concretion, 478
 fistula, 489
 impaction, 462
Fæces, examination for blood in, 443
Fallopian tubes, gonococcal inflammation, 31
 hernia of, 421
Familial chronic hæmolytic anæmia, 513
Fascial grafts in hernia, 433, 435, 437
Fascial sling for recurrent dislocation, 211
Fat necrosis in pancreatitis, 506
Fatty hernia of the linea alba, 437
Felton serum, 13
Femoral hernia, 434
Femur, fractures of, 231
 epiphyseal fracture of, 233
 fracture of shaft of, 232
 subtrochanteric fracture, 231
 supracondylar fracture of, 233
Fever, aseptic traumatic, 51
 catheter, 593
 septic traumatic, 51
 hectic, 11
Pel-Ebstein, 100

Fibro-adenoma of breast, 398
Fibroblasts, 50

Fibro-cicatricial tissue, 49
-cystic disease of bone,
139, 140
of jaws, 300
-lipoma, 64
-sarcoma, of jaws, 300
extra-periosteal, 143
of stomach, 456

Fibroid of Paget, recurrent,
408

Fibroma, hard, 64
of jaws, 300
of larynx, 372
of muscles, 117
naso-pharyngeal, 328
of neck, 350
of palate, 321
soft, 64
of spine, 267
of stomach, 456
of tongue, 311

Fibromyoma, 65

Fibrosa, generalized osteitis,
138

Fibrositis, rheumatic, 117

Fibrous epulis, 297
odontoma, 300
stricture of œsophagus,
337

Fibula, fractures of, 241

Fifth nerve, lesions of, 106

Filaria Bancrofti in elephan-
tiasis scroti, 607
sanguinis hominis, 97

Finger, congenital contrac-
ture of, 170

Dupuytren's contracture
of, 168

mallet, 169

snap, 170

webbed, 170

Finsen light in lupus erythe-
matus, 121

First intention, healing by, 50
nerve, injury to, 105

Fisher's frame in scoliosis, 165

Fissure, anal, 530

Fissured fracture of skull, 271

Fistula, aerial, 350

ano-rectal, 521

biliary, 505

branchial, 351

cæcal, 468, 489

colic, 468

• definition of, 12

fæcal, 467

gastric, 451

gastro-colic, 449, 451

ileal, 468

in-ano, 521

jejunal, 468

masseteric, 317

parotid, 316

pleuro-bronchial, 380

salivary, 316

submaxillary, 317

supra-pubic, 575

thyroglossal, 353

umbilical, 408

urinary, 599

vesico-colic, 576

vesico-vaginal, 576

Flat-foot, 180-181

Floating kidney, 544

Fluctuation in abscess, 9

'Foam' cells in xanthoma, 65

Focal sepsis, 2

in osteo-arthritis, 156

in rheumatoid arthritis,

147

The Foot, 245

Foot, claw-, 182

club-, 177

Forceps, pressure, in arrest of
hæmorrhage, 56

Spencer Wells, 56

Forearm, injuries of, 219

Foreign bodies, in bladder,
566

in bronchus, 368

in ear, 341

fæcal obstruction by,
473, 478

in larynx, 367

in nose, 322

in œsophagus, 335

in pharynx, 367

in rectum, 516

- Foreign bodies* in stomach,
440
in trachea, 368
in urethra, 597
- Formalin injections* for hydatid cyst, 496
- Fourth nerve*, injury to, 196
- Fowler position* in appendicitis, 488
- Fractional test meals* in gastric ulcer, 443
- Fractures*, 194
abnormal mobility in, 198
of anterior inferior spine, 257
of anterior superior spine, 257
of astragalus, 247
avascular bone - necrosis in, 197
bedsores during treatment of, 190
of carpus, 222
causes of, 194
of clavicle, 206
of coccyx, 257
Colles', of radius, 220
comminuted, 195
complete, 195
complicated, 195
compound, 194
of coracoid process, 208
crepitus in, 198
crutch palsy in treatment of, 194
delayed union in, 196
diagnosis of, 197
Dupuytren's, 242
epiphyseal, 195
of femur, Balkan frame in, 232
of great trochanter, 231
epiphysis of, 231
of lesser trochanter
epiphysis of femur, 231
of shaft, 232
of upper epiphysis of femur, 230
- Fractures of fibula*, 241
fissured, of skull, 271
of humerus, 208
of humeral condyles, 215
of humeral head, 208
of hyoid bone, 348
of ilium, 257
immobilization in, 199
impacted, 195
incomplete, 195
infected, 202
of ischium, 257
joint stiffness in, 196
Kirschner's piano-wire traction for, 198
of mandible, 298
manipulation in, 198
of maxilla, 298
of metacarpals, 224
of metatarsals, 248
of nasal bone, 322
of neck of femur, 228
non-union of, 195
bone grafts in, 200
open, 194
open operation in, 199
of os calcis, 245
of patella, 237
pathological, 203
of phalanges, 226
Potts, 242
of pubis, 256
radiography in, 198
of radius and ulna, 219
reduction of, 198
repair of, 195
restoration of function in, 200
of rib, 373
of sacrum, 257
of scaphoid, 222
of scapula, 207
simple, 194
of skull, 271-272
Smith's, of radius, 222
of spine, 248
comminuted type of, 249
compression type of, 249

- Fractures* of spine, hyper-extension type of, 250
 paraplegia in, 252
 spinous process, 250
 suprapubic cystotomy in, 253
 transverse process, 250
 wedge type of, 249
 spontaneous, 139
 of sternum, 374
 of sustentaculum tali, 245
 of tibia, 241
 and fibula, 239
 of tibial spine, 239
 of tibial tubercle, 238
 of tibial tuberosity, 238
 traction in, 198
 of ulna, 219
 varieties of, 194
 of vertebral bodies, 248
 Volkmann's contracture during treatment of, 167
Fragilitas ossium, 203
Framboesial proctitis, 518
Fröhlich's syndrome, 291
Frontal sinusitis, 326
Frost-bite, 49
Fungus of ergot, 192
Fungus testis, 612
Furuncle, 16
Furunculosis, 121
 of ear, 341
Gaillard-Thomas operation on breast, 398
Galactocoele, 397
Galactose-tolerance test in thyrotoxicosis, 362
Gall-bladder, 497
 carcinoma of, 505
 injuries of, 497
 obstruction of, 478
 torsion of, 497
Gallies' operation for hernia, 433
Gall-stones, 500
Galvano-puncture for aneurysm, 87
Ganglia, removal of sympathetic, 115
Ganglioneuroma, 74
Ganglion, 118
 compound palmar, 118
Gangrene, 6, 188
 aseptic, 188
 of bowel in strangulation, 426
 diabetic, 191
 dry, 188
 embolic, 190
 endarteritis in, 191
 ergot, after, 192
 ganglionectomy in, 191
 gas, 192
 indirect, 189
 infective, 189
 moist, 188
 peripheral neuritis in, 191
 senile, 190
 septic, 188
 symmetrical, 191
 syphilitic, 191
 traumatic, 189
Gas gangrene, 192
Gastric carcinoma, 453, 456
 fistula, 451
 lavage, 451
 tetany, 448
 ulcer, 441
 acute, 441
 complications of, 446
 chronic, 442
 perforation of, 446
Gastritis, acute phlegmonous, 441
Gastrocnemius muscle, rupture, 116
Gastro-colic fistula, 451
Gastro-jejunal ulcer, 449
Gastroptosis, 451
Genu recurvatum, 176
 valgum, 175
 varum, 175
Giant-cell benign tumour, 66
Gigantism, 290
Gillies' operation, for cleft palate, 321

- Gimbernat's ligament in femoral hernia, 423, 434
 Glanders, 41
 Glandular areas in carcinoma, 70
 Gleet, 28
 Glénard's disease, 451, 461
 Glioma, 73, 288
 Globus hystericus, 336
 Glomangioma, 65
 Glomus tumour, 126
 Glossitis, acute, 307
 parenchymatous, 308
 streptococcal, 309
 superficial, 307, 308
 Glosso-pharyngeal nerve, injuries to, 108
 Glossy skin, 103
 Glottis, œdema of, 370
 Gluteal bursa, 120
Goitre :
 benign metastasizing, 359
 carcinoma simplex, 359
 squamous, 360
 colloid, 357
 endothelioma, 360
 exophthalmic, 361
 heart, 366
 intrathoracic, 358
 iodine prophylaxis in, 357
 malignant adenomatous, 359
 neoplastic, 359
 nodular, 357
 parenchymatous, 356
 radium therapy in, 360
 secondary toxic, 357
 simple, 355
 substernal, 358
 surgical removal, 363
 teratomatous, 360
 toxic, 360, 361
 X-ray therapy in, 363
 Gomenol in cystitis, 568
 Gonococcal arthritis, 31
 conjunctivitis, 30
 epididymo-orchitis, 609
 fibrositis, 31
 inflammation of Fallopian tubes, 31
 peritonitis, 415
 Gonococcal proctitis, 31
Gonococcus, 14
Gonorrhœa, acute, 28
 autogenous vaccine in, 29
 chemotherapy in, 32
 in children, 32
 chronic, 29
 complications of, 30
 in females, 31
 prophylaxis of, 28
 test of cure, 30, 31
 Gonorrhœal warts, 30
 Gout, arthritis in, 147
 chronic neuritis in, 104
 Gouty bursitis, 120
 Graefe's, von, ocular sign, 362
 Grafts, bone, 290
 fascial, in hernia operations, 433
 skin, 187
 Grafting, thyroid, 367
 Granulation, healing by, 50
 tissue, 50
 Granuloma of brain, 289
 Granulomatous diseases, 7
 Graves' disease, 361
 Grawitz' tumour, 560
 Great sciatic nerve, injury to, 112
 Ground-glass cornea in syphilis, 38
 Gumboil, 296
 Gunma formation in syphilis, 38
 Gummatous arthritis, 155
 osteitis, 135
 proctitis, 518
 Gums, affections of, 296
 Gunshot wounds, 45
 Guyon, diffuse prostatopelvic carcinoma of, 569
 Gynæcomastia, 392

 Hæmatemesis, 446
 complicating appendicectomy, 489
 Hæmatocœle, 618
 Hæmatoma, 44
 auris, 341
 of scalp, 270

- Hæmatospermia**, 593
Hæmaturia in bladder growths,
 " 570
 in prostatic enlargement,
 584
 in renal calculus, 555
 in renal injury, 545
 in renal neoplasms, 561
 in renal tuberculosis, 552
Hæmolytic anæmia, 513
 jaundice, 513
Hæmophilia, 60
 joint lesions in, 158.
Hæmorrhage, 55
 arterial, 55, 58
 varieties, 55
 capillary, 53, 60
 chronic subdural, 279
 encysted subdural, 279
 extradural, 277
 general treatment of, 56, 57
 in fractured skull, 277
 in gastric ulcer, 466
 intracranial, 277
 from birth injuries,
 279
 intradural, 278
 middle meningeal, 277
 natural arrest of, 56
 primary, 58
 reactionary, 59
 secondary, 59
 symptoms of, 55
 tourniquet in arrest of, 59
 treatment of, 55
 venous, 60
Hæmorrhoidal plexus, varix
 of, 526
Hæmorrhoids, 526-528
Hæmostatic bag in prostatec-
 tomy, 587
Hæmothorax, 376
Hair-ball in stomach, 440
Hallus flexus, 183
 rigidus, 183
 valgus, 182
Hammer-toe, 183
Hand, 386
 acute lymphangitis of,
 390
 'collar-stud' abscess of,
 390
 fascial space abscess i
 390
 paronychia of, 388
 pulp infections of, 388
 tenosynovitis of, acute
 389
 tuberculous, 11
Hard-rays in radiotherapy 76
Hare-lip, 292
Harrison's whip bougie in
 retention of urine, 579
Harris method, prostatectomy,
 587
Hartmann's operation for car-
 cinoma rectum, 539
 pouch, 501
Hashimoto's struma, 355
Head injuries, 271
 after-effects of, 279
Healing of wounds, 49-50
Heart, injuries of the, 385
 surgery of the, 385, 386
 -tamponade, 375, 385
Heberden's nodes in osteo-
 arthritis, 157
Hectic fever, 11
Hemianopsia, 289
Hemiglossitis, 307
Henoch's purpura, 481
Heparin in thrombosis, 92
Hepatoptosis, 492
Hernia, 419
 acquired inguinal, 429
 cerebri, 292
 complete inguinal, 428
 complications of, 422-423
 congenital funicular, 428
 oblique inguinal, 428
 umbilical, 435
 vaginal, 428
 constriction groove in, 42.
 contents of, 420
 coverings of, 420
 diaphragmatic, 438
 direct, 429
 en bissac, 430
 encysted, 428
 en glissade, 420

Hernia (continued):

- epigastric, 437
- etiology of, 419
- extraparietal, 430
- fatty, of the linea alba, 437
- femoral, 433
- incarcerated, 422
- incisional (ventral), 436
- inflammation of, 422
- inguinal, 428
- internal, 475
- interparietal, 430
- interstitial, 431
 - inguinal, 430
 - peritoneal, 430
- irreducible, 422
- labial, 428
- Littre's, 420
- lumbar, 438
- Maydl's strangulated, 424
- neck of, 420
- oblique inguinal, 428
- obstruction of, 422
- obturator, 438
- of appendix, 421
- of bladder, 421
- of Fallopian tube, 421
- of muscle, 116
- of the ovary, 421
- reducible, 421
- reduction *en bloc*, 426
 - en masse*, 426
- retroperitoneal, 475
- Richter's, 420, 424
- sac of, 420
- sciatic, 437
- scrotal, 428
- signs and symptoms of, 421
- silver wire filigree for (ventral), 437
- sliding, 420
- strangulation of, 423
 - after-treatment, 427
 - pathology, 423
 - post-operative complications in, 427
- strangulation of, signs and symptoms, 424
- treatment, 425

Hernia (continued):

- taxis in, 425
- of testis, 609
- through linea semilunaris, 437
- trusses for, 433
- umbilical, 435
- varieties of, 438
- ventral, 436, 489
- Hernial sac, hydrocele of, 489
- Herpes of the penis, 604
- Herpetic ulcers of lips, 293
 - of tongue, 310
- Hexamine in cystitis, 568
- in incontinence, 577
- Hexyl-resorcinol in cystitis, 568
- in incontinence, 577
- Hibb's operation, 167, 264
- High-voltage therapy, 78
- Hill's tube in carcinoma of oesophagus, 339
- Hilton's method of opening abscess, 10
- Hip:*
 - Charcot's disease of, 157
 - clicking, 174
 - congenital dislocation of, 170
 - dislocation of, 230
 - injuries of, 227
 - tuberculosis of, 152
- Hippocratica, facies, in peritonitis, 410
- Hirschsprung's disease, 115, 460
- Histamine in shock, 52
- Hodgen's splint, 232
- Hodgkin's disease, 100
- Hooklets in hydatids, 81
- Horsehair sutures, 4
- Horseshoe kidney, 543
- Hourglass stomach, 449
- Housemaid's knee, 119
- Humerus, injuries to, 208, 209, 212-217
- Hunter's operation for aneurysm, 87
- Hurst's bougie, mercury-loaded, 387

- Hutchinson's teeth, 38
 wart, 310
 Hutchinson's tumour, 563
 Hydatid disease, 80
 of bone, 140
 of liver, 495
 of thyroid gland, 355
 thrill, 496
 Hydrarthrosis, 146
 Hydrencephalocele, 282
 Hydrocephalus, 283, 289
 Hydrocœle, 615
 bilocular, 616
 congenital, 618
 diffuse, of cord, 618
 encysted, of cord, 617
 of epididymis, 614
 infantile, 616
 of neck, 352
 secondary, 618
 vaginal, 615
 Hydronephrosis, 545
 Hydrophobia, 26
 Hydrops of gall-bladder, 501
 tuberculous, 149
 Hygroma, cystic, 97
 Hypernephroma, 560
 Hyperparathyroidism, 138
 Hyperpituitarism, 289
 Hyperplastic tuberculosis of
 intestines, 465
 Hyperthyroidism, masked, 362
 Hypertrophic osteo-arthro-
 pathy, 138
 rhinitis, chronic, 324
 Hypogastric plexus, 114
 Hypoglossal nerve, injuries
 to, 108
 Hypopituitarism, 289
 Hypospadias, 594
 Hypothyroid states, 365
 Hysterical spasm of the œso-
 phagus, 336
 Ileitis, regional, 466
 Ileus, adynamic, or paralytic,
 483
 Ilium, fracture of, 257
 Immunity, 13
 Immuno-transfusion, 13
 Imperforate anus, 515
 Implantation dermoid, 79
 Incisional hernia, following
 appendicitis, 489
 Incontinence of urine, 576
 'Infant Hercules,' 563
 Infections, surgical, 22
 Infective thrombosis of venous
 sinuses, 286
Inflammation, 5
 chronic, 7
 Influenza and appendicitis,
 485
 and chronic neuritis, 104
 Injection treatment of hæmor-
 rhoids, 529
 of hernia, 433
 Insect stings, 47
 Instruments, sterilization of, 4
 Insulin, pre-operatively, 2
 Intercondylar fractures of
 humerus, 215
 Internal popliteal nerve, in-
 jury to, 112
 Interstitial keratitis, 38
 Intervertebral disc, injuries
 of, 254
 Intestinal obstruction, acute,
 472
 acute on chronic, 484
 chronic, 484
Intestines, affections of the,
 459
 neoplasms of, 468
 stricture of, 466
 tuberculosis of, 465
 Intussusception, 478
 acute, 478
 chronic, 482
 retrograde, 482
 varieties of, 480
 Intrathoracic tumours, 384
 Involution, 129
 Iodine, Lugol's tincture of,
 362
 for operation area, 4
 in osteo-arthritis, 157
 Iritis, syphilitic, 34
 Irradiated ergosterol, 137
 Irradiation (*see* Radiotherapy)

